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CONTENTS OF VOLUME XVI., Pt. I.

Art. I.—*Rocks and Ore Occurrences at Bethanga and the Lower Mitta Mitta.*

By HENRY C. JENKINS

(Wh. Sc., A.R.S.M., Assoc. M. Inst. C.E.).

(With Plate I.).

[Read 11th December, 1902.]

The author has had occasion recently to visit several places along the Mitta Mitta Valley, including Bethanga, Snowy Creek, Lightning Creek, Mount Elmo and Sandy Creek, and as there does not appear to be a large amount published as regards the character of the district beyond the somewhat general and comprehensive description that it is a metamorphic area, he thought it would be of interest to describe, as far as a fortnight's inspection would justify, some of the rocks there, and more particularly the mode of occurrence of the minerals of economic importance.

Although the greater part of the journey was over ground marked upon the Victorian Geological Map of 1902 as being metamorphic, yet the line also passes over ground marked lower silurian, between Eskdale and Lightning Creek, and of granitic rocks at Granite Flat, and its peak. A rapid journey over the so-called lower silurian exposure would not justify more than the suggestion, yet it would be desirable to raise the question as to the value of the precise geological evidence upon which the distinction has been made between the rocks at this particular part of the country and some of those of the part marked metamorphic, the resemblance being so close that in the absence of definite palæontological evidence, or of marked unconformity it is doubtful whether a distinction is legitimate. Any such evidence as the inclusion of the materials of one bed in another would be quite inadmissable in the case at Snowy Creek, where the beds so closely resemble one another. The author will also submit some reasons for viewing the line through Bethanga

and the head of Little Snowy Creek, as being an axis of very old rocks, such as would make the exposure from there down to as far as the so-called hornfelds at Ensay in Gippsland, to be really that of the oldest rocks to be seen in Victoria.[1]

There are also some unmarked exposures of holocystalline rocks along the Snowy Creek, one at about seven miles to the southward of Granite Flat is of considerable size, and larger than some exposures that are marked as being granitic. But these holocrystalline rocks of the district have in most cases, even where originally intrusive, undoubtedly undergone great changes just as have the schists, and all these cases illustrate the difficulties arising out of the present official nomenclature. The holocrystalline rocks on the western bank of the Mitta Mitta, about six miles southward from Tallangatta, form one case in point, and those much to the southward in the Ensay district furnish another case.

The occurrence of gold at Lightning Creek, at the head of the Snowy Creek toward Mount Wills, presents an interest from the fact that rich alluvial was found in the creek in the early gold digging days, and that the diggers, reasoning from the analogies elsewhere, made many attempts to find the lode from which it had been supposed to have been shed. The country is, however, of the heaviest character for prospecting; with steep hillsides, narrow rapid creeks and much timber and scrub, and up to the present date that lode has never been found. The rocks are silky micaceous schists and quartzites, and it does not seem necessary to postulate the presence of a large lode to account for the coarse alluvial gold. Quite recently Mr. J. F. McCann has obtained much rich coarse gold from a spot that years ago had been cleared of its timber and had had the trestles of a large flume erected upon it by men who were prospectors by instinct, without the gold being seen at the time. This was on a spur facing to the south west at the junction of the Lightning and Snowy Creeks, and the deposit of gold was in a thin irregular seam of quartz, parallel to the ancient bedding planes of the present schists that are now nearly upright and lying about 20 degrees west of true

[1] The author would refer to the highly interesting and important work upon the ks at Ensay and Omeo, by Mr. A. W. Howitt, and published in the Proceedings of the l Society of Victoria, and in the Victorian Departmental publications.

north. From one pit only twenty feet deep and about 7 feet long he obtained 100 ounces of gold from specimen quartz, and it is easy to see that by the denudation of a band of rock such as this lying nearly parallel to the average trend of the valley, these little pockets, even at some distance apart, would be ample to supply the alluvial gold.

The granitic area at Granite Flat is really one of a quartz diorite. The rock slide shows plagioclase felspar, green and brown hornblende, some mica in places, and pegmatitic quartz full of solid inclusions that are very minute and may be rutile. The area is traversed by fissure veins that seem generally to be small. Some of those that run in an east and west direction have copper pyrites as a lode filling, one that seemed larger than the average (*i.e.* that on the Empress of India lease) had copper pyrites, iron pyrites, quartz, carbonate of lime and gold, and a copper sulphide much resembling "glance" in appearance but not so rich as that mineral in copper. A full discussion of the occurrences would be, however, somewhat outside of the scope of this paper.

The area that is undoubtedly of metamorphic rocks includes the Little Snowy Creek. In this area there is a strip of country from Mount Elmo through Scrubby Creek, Lockhart's Gap and Bethanga, along which, at greater or less intervals, rich gold deposits are found. The deposits are not always in large lodes, and occasionally they are not in well marked ones, but this latter is the exception. The deposits are undoubtedly valuable from an economic point of view as well as interesting from the scientific one. Eastward of this series is one of tin occurrences that I have not been able personally to see *in situ*, but they appear to extend from a point a few miles eastward of Mount Elmo, to across the Mitta Mitta at Eskdale, and thence to Tallangatta and to the Murray River. The specimens that have reached me are all of greisen with cassiterite in very coarse crystals. The occurrences are doubtless isolated ones and so far have not been "proved" from an economic point of view, but this by no means indicates them to be worthless; indeed, the general want of knowledge locally as regards ore treatment prevents these tin deposits from being fairly tested at the present date.

Adverting, however, to the occurrences of gold, that at Mount Elmo will now be considered. The rocks amongst which it is found are quartzites with mica and andalusite schists, and these are associated with holocrystalline rocks, some of which are undoubted metamorphosed, whilst there are others about which some reserve must be made, but which will probably prove also to be of metamorphic character, and which appear to have been intrusions that already existed in the area prior to the period at which the change from shales to schists took place.

Mount Elmo lies about three miles south east by east of the trigonometrical survey station of Mount Towanga, and the field is reached from Eskdale by one of the new roads of the Mines Department following the western or main branch of the Little Snowy Creek. The mines are upon several lines of reef, a considerable distance apart, two of which are at Mount Elmo, where they dip with and follow the ancient bedding planes of the country. The dip is 65 degrees east and the strike is about 10 degrees west of true north. The reefs at Mount Elmo have not yet been traced for a distance of more than about 1½ miles, and are, as far as prospected, cut off completely by the bands or masses of the holocrystalline rocks just mentioned. The author was not able to visit the mass at the southern end of the line of reef, but at the northern end, lying between the Little Snowy Creek and the mountain spur containing the reef outcrops themselves, the band is variable in character. One mass that he saw was a tourmaline rock with felspars and muscovite, whilst another showed upon slicing, felspar, muscovite and biotite, some quartz exhibiting much strain structure and containing small fibrous inclusions, probably sillimanite, light brown hornblende and tremolite.

The top of the mountain, somewhat to the eastward of the line of reef, is of greisen, a mass of which appears to lie parallel to the schists, but there was not an opportunity to trace out its extent.

The part of the mountain where the more westerly of the two reefs is exposed is an andalustic and mica schist, the andalusite crystals showing up very well upon the weathered surfaces on the mountain side. The reef lies between a dense impervious bed of black quartzite and a bed of andalusite schist of a few feet thickness, on the other side of which a second bed of the black impervious quartzite is found. These black quartzites are

manifestly the remains of the old sandstones, and the andalusite schist that of old shales; the partings between the two classes of rocks are still quite distinct. It may be here noted that the quartzite forms the hanging wall of the reef whilst the schist footwall has been distinctly affected and attacked by the filling of the reef. This reef is from six inches thick up to one foot six inches thick, and in the Lone Hand mine, where the author was able to examine it, had shown an almost continuous "shoot" of auriferous stone for three hundred feet, with values varying from a few pennyweights up to several ounces of gold per ton. One interesting feature here, as in the case at the Lightning Creek, is the parallelism of the auriferous deposit to the old bedding planes, but the case under notice shows in addition the controlling action of the hard quartzite beds upon the direction and concentration of the deposits, deposits doubtless initiated along the planes of weakness due to the dissimilar characters of the beds of schist and of quartzite and accentuated by metasomatic action when once started. The holocrystalline rocks at the ends of the beds have doubtless also acted as controlling factors, limiting the extent of the deposit, and it must remain for the present an interesting speculation as to how far gold was derived from them. Although there have been prospecting operations in many parts of the field, yet the useful deposit appears to lie wholly in the two reefs to which reference has just been made.

There are a number of small rich deposits at Scrubby Creek, near Tallandoon, that from the description given to the author may well correspond to the occurrence at Mount Elmo, but these he was unable to visit. Some of the specimens showed however galena to be present in the lode fillings.

At a point about three miles north westward of Lockhart's Gap there is another auriferous deposit of considerable extent lying not in a lode but in a band of holocrystalline metamorphic rock, showing idiomorphic quartz crystals and pegmatitic growth with the other constituents. It carries iron pyrites and free gold, the latter sometimes to a sufficient extent to make it a valuable gold ore, and its presence is itself sufficient to account for the fine alluvial gold along the creeks now being sluiced below it, just as in the case of the deposits at Lightning Creek.

The ore occurrence an Bethanga is one of very great interest in itself and was that to which most attention was paid for the purposes of the paper. The mines at Bethanga are upon several parallel lines of lode that have a general direction of 30 degrees east of north. One of these main lines and some subsidiary ones traverse the length of Mount Talgarno for nearly a mile, this portion of the mine the author could only examine on the surface.

At a point about half a mile to the eastward of the southern end of the first lode, there is a second one known as Conness' that continues southward past a bifurcation that occurs, and until it reaches a fault line running nearly east and west and which throws it about five chains eastward. Its continuation southward of the fault forms the Gift mine for a distance of about three thousand feet, but three hundred feet of this nearest to the fault is not yet opened. This mine has three shafts, the "Gift," "Martin's" and "Leighton's," in the order named, going southward, of which Martin's and Leighton's are the deepest, owing to the slope of the ground. Martin's shaft is 800 feet deep.

A third lode also, broken by the fault, lies about half a mile to the eastward of the Conness and Gift line—this lode has the Welcome mine in its northern end and the Excelsior mine in its southern portions respectively.

A careful inspection of the surface showed that these lodes were each in similar rocks typical of the district and this enabled the author to concentrate his attention on the Gift and Leighton mine where most work is in progress at the present time, and where an exposure 800 feet from the surface can be seen.

The whole of the district around the mine is of schistose and gneissic rocks, passing from manifest biotite and other schists, characterized by much contortion, into a holocrystalline rock or gneiss with the characteristic structure often resembling an intrusive one in the field, but which proves on slicing to be of oligoclase, biotite mica, very pale brown hornblende, some quartz showing much strain structure, garnets surrounded by chlorite and with very beautiful fibrolite, and small idiomorphic cordierite[1]—two typical slices are shown in Figures No. 1 and No. 2.

1 Cordierite has recently been recorded as occurring at Wood's Point by F. P. Mennell —Geolog. Mag., Sept. 1902.

The association between the hornblende or with the chlorite and the fibrolite does not appear to be accidental. The lode track is in this rock mass, it follows the line of rock that is most completely metamorphosed, and although it is well defined, its filling is, apart from the mineral contents, essentially the same as the country, there is a little more quartz at some places and in a few others a hard chloritic "pug" impregnated with pyrites and presenting slickensides is found. The metallic minerals are arsenical and ordinary iron pyrites, and copper pyrites, all carrying gold. There are very few vughs, but where these occur they show crystalline quartz and calcite upon iron pyrites. The copper, but not the gold contents, increase toward the line of the east and west fault.

The analysis of the rock from several different places is shown in the table. Analysis (A) is of the rock adjacent to lode track in No. 2 level at the Gift shaft end, whilst analysis (B), (C), (D), are from samples collected along No. 5 cross cut (about 700 feet) on Martin's shaft. (B) being from near to the lode track, (D) from about 70 feet distance and (C) from a point intermediate between (B) and (D). The rock has however large segregation of oligoclase and small garnets, and no single analysis would fairly indicate its composition. Analysis (E) is of the felspar which is thus shown to be oligoclase.

	No. 2 Level	No. 5 Cross Cut			Felspar
Analysis	(A)	(B)	(C)	(D)	(E)
SiO_2	58.14	71.01	67.37	66.86	70.60
Al_2O_3	17.92	10.74	11.78	11.76	19.08
Fe_2O_3(and FeO)	12.71	5.19	5.43	6.72	trace
CaO	.65	3.36	2.50	1.02	2.94
MgO	.23	1.50	2.37	1.23	0.79
Na_2O	3.12	4.47	3.05	7.89	4.60
K_2O	3.02	2.38	3.81	3.86	1.78
P	.20	trace	.43	trace	—
S	nil	—	nil	—	—
Cl	.15	trace	trace	—	—
Water at 100°C.	.72	0.32	nil	0.67	—
Water above 100°C.	3.60	1.41	2.50	0.48	—
	100.46	100.38	99.24	100.49	99.79

The lodes are only of moderate average thickness say, of 1 foot and 1 foot 6 inches, but the contents are fairly rich, an average of 1½ ounce gold per ton has been obtained over a considerable period of working. The lode filling therefore shows a high grade of concentration.

The lode track is full of small slickensides, that are interesting when viewed in connection with the contorted schist of the neighbourhood, and to the regular and solid rock mass adjacent to it.

Referring now generally to the facts recorded as to Bethanga, Mount Elmo and Lightning Creek, it will be noticed that there is a parallelism of the strike of the deposit to the ancient bedding planes seen or inferred in each case, and, at the same time, the deposit is not of the "contact" class. This same parallelism is a marked feature of many of the deposits in the schists of the Western Coast of Tasmania, only there the deposits are prominently connected with metasomatic action, during which action the element fluorine has often been present in so much quantity as to bring about the production of minerals such as axinite, datolite, fluorite and tourmaline, to such an extent as to somewhat mask the original features. The same feature of parallelism is involved in the now generally accepted reading of the Broken Hill occurrence, as being an extreme case of a saddle information in schist, and, it is interesting in passing, to note that, at the latter place, Mr. J. C. Moulden[1] has recorded the presence of cordierite but as a primary constituent of the rock. Although the evidence, if not otherwise supported, would not be in itself strong, nevertheless, there is in it a considerable suggestion as to similarity of origin.

All the occurrences described in the paper have common features, but these features differ greatly in degree. The crystalline rocks or gneisses at Bethanga offer the extreme case of metamorphosis just as do the gneissose masses at Ensay or the crystalline schists at Broken Hill or in North Western Tasmania, and in addition to this they exhibit extreme concentration of mineral in a narrow lode track. The auriferous rocks at Mount Elmo exhibit both of the same phenomena to a much smaller degree, whilst the occur-

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1 Jour. Roy. Soc. N.S.W.

rence at Lightning Creek is but an instance of the diffuse charging of schistose rocks with auriferous material. In the case of Lockhart's Gap there is a diffuse charging of holocrystalline rocks with metalliferous minerals. In all these four cases the author would however submit that the action by which they received their gold was a comparatively deeply seated one, as indicated by the presence of quartz, a substance that is in all probability present in the particular form in which we find it in lodes owing to a comparatively elevated temperature of the water current that carried the other mineral matter in course of deposition.

These deposits thus differ in a very important manner from the auriferous sandstone reefs to which the author has elsewhere drawn attention[1] as occurring in Victoria, and that have distinctly received their gold when much nearer to the surface as is shown by the absence of quartz—that mineral when it occurs in such reefs being found quite independently of the gold, and offering no guide to the occurrence of the latter. The gold in this case, although in silurian sandstone, was probably deposited at a much less remote date than that of the occurrences forming the subject matter of the paper and probably in late tertiary times.

The rocks at Bethanga show the interesting case where extreme earth pressure and local yielding has, owing to the work thereby done upon the rock, given rise to a development of heat so considerable as to bring about softening and a subsequent recrystallization of the mass, an unstable condition of affairs that relieves the earth stress[2] at a distance at the expense of the place where the movement first starts, and which, when it occurs near to a volcanic vent, is, the author would submit, the cause of a flow of fluid lava and the explanation of many volcanic phenomena. In the case under notice at Bethanga temporary planes of weakness must be assumed to have been left that were disturbed again before the zone had completely cooled down to the average temperature corresponding to its depth. Such planes may indeed have been initially formed by the contraction of the

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1 "Some Auriferous Deposits," Report Australasian Assoc. Science, vol. viii. Melbourne Meeting, 1901, p. 227.

2 One place where such a state of strain in the strata is manifest at the present moment is at Hillgrove, N.S.W. See official N.S.W. Report on Hillgrove Gold Field by Andrews, 1901, p. 18.

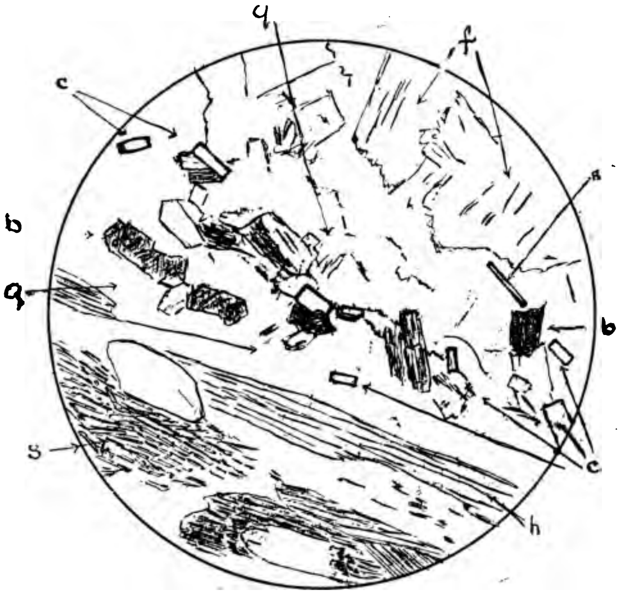
cooling mass after the original severe lateral pressure had been relieved, but this is a less likely explanation on several grounds. The planes of fracture would, in whatever way in which they were formed, become convenient courses at a later date for water currents in the earth to take, these would bring with them the minerals subequently deposited. The deposit has evidently not been completed at one period of time, for although there does not appear to have been the phenomenal surface enrichment of the lode seen on many of the Victorian fields, yet there is the enrichment of the lode in copper to be accounted for at the places adjacent to the main east and west fault plane.

At Mount Elmo the plane of weakness was evidently given by the still distinct bedding planes between the quartzites and schists whilst the two impervious beds of quartzite kept the subsequent water current to a definite course and with it the deposit. In the case of Lightning Creek, metamorphosis had not proceeded to so great an extent, and in the absence of dykes or fault planes the deep seated aqueous currents were not so confined—so that even though rich deposits of gold could and did occur they were individually smaller and generally more diffuse. Although in all probability belonging to the same period of time it presents the extreme opposite case to the concentration of mineral seen at Bethanga, owing to the different degree of permeability to aqueous currents that it possessed.

EXPLANATION OF PLATE I.

Fig. 1.—A typical section of the gneiss. There is hornblende (*h*) —pleochroism very pale yellow to pale brown, Sillimanite, (S)—occasionally as single inclusion in quartz, but more often occupying areas amongst the hornblende. Biotite Mica (*b*) Cordierite (*c*) generally as simple prismatic crystals grouped and single and lying amongst biotite or in quartz (*q*) this latter showing much strain figure in polarized light. The felspar (*f*) are both of twinned and simple areas.

Fig. 2.—Is an actual section taken from one of the felspathic aggregations in the gneiss in the lower part of mine. There are garnets (*g*) each more or less completely



N × 40 d

Fig. 1.

N × 20 d

Fig. 2.

surrounded with green chlorite (*ch*) some of which is passing into brown areas, and outside this is a densely matted mass of fibrolite (*fb*) in a quartz matrix. Felspar (oligoclase) is shown almost surrounding the field.

Sample from No. 5 cross cut, Gift Mine, Bethanga.

ART. II.—*Geology of the Valley of the Lower Mitchell River.*

By JOHN DENNANT, F.G.S., F.C.S.,

AND

DONALD CLARK, B.C.E.

(With Plates II. to VIII.).

[Read 11th March, 1903].

CONTENTS.

I.—INTRODUCTION.

The previous literature dealing with this portion of the Mitchell River area consists of:—

(1) Notes on the Geology of part of the Mitchell River division of the Gippsland Mining District, by A. W. Howitt, F.G.S.[1]

(2) Continuation of ditto[2].

(3) Notes on the Physical Geography and Geology of North Gippsland, Victoria, by A. W. Howitt, F.G.S.[3]

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1 Geological Survey of Victoria. Reports of Progress, No. ii., 1874.

2 Ibid., No. iv., 1877.

3 Q.J.G.S., vol. xxxv., 1879.

(4) Notes on Miocene Strata at Jemmy's Point, and

(5) Appendix to remarks on "The Older Tertiary Strata at Bairnsdale," by J. Dennant.[1]

(6) The Miocene Strata of the Gippsland Lakes' Area, by Dennant and Clark.[2]

In the last mentioned paper certain ferruginous beds at Boggy Creek and elsewhere on the Mitchell River were briefly referred to, and in a footnote it was stated that from an examination of their fossil contents they have been determined as miocene. A detailed study of the material since gathered from various outcrops on the river bank proves, however, that this statement is only partially correct. For a short distance from Bairnsdale the beds are undoubtedly miocene, but higher up the river the fossil casts in the ironstone represent, as we shall presently see, an older fauna.

These fossiliferous ironstones form a marked feature of the Mitchell River banks, and the main purpose of the present paper is to describe them and refer them to their proper location in the tertiary series. They have been generally alluded to in the past as a deposit of uniform age which it was supposed had filled in an excavated area at the contact of the Bairnsdale limestones and the Avon sandstones. We, however, separate them into two main divisions, one of which is miocene, and a westerly extension of the Jemmy's Point beds, and the other earlier, and contemporaneous with the eocene limestones and shell beds of the river banks.

Another deposit which claims attention is the well known pebble drift or conglomerate. In the bed of the river, on its banks, in road and railway cuttings, it is everywhere prevalent. Its origin and the mode of its distribution will be referred to as the various sections come under review.

II.—Surface Configuration of Area.

Under this heading the leading features of the valley of the Mitchell from Iguana Creek to the mouth of the river are outlined.

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1 Proc. Roy. Soc. Vict., vol. iii., n.s., 1891.

2 Proc. Roy. Soc. Vict., vol. x., n.s., 1898.

The Mitchell River after flowing in a southerly direction through rugged and hilly country consisting of devonian sandstones, shales, and conglomerates turns sharply to the east when it enters the tertiaries and continues in this course until it discharges into Lake King. The watershed on the southern side is comparatively narrow. Moitun Creek, after flowing through devonian rocks, enters the Mitchell as it passes into the tertiaries, and the only other creeks discharging into it on this side are Lucas Creek, which joins it near Perry's Bluff, and Cobbler's Creek, which, after passing through McLeod's morass, junctions with the river near Eagle Point. The watershed line consists of a high sandy ridge which starts from the devonian hills, three or four miles to the south of Moitun Creek and continues in a direction approximately parallel to the course of the river. The height of the ridge is about 400 feet above sea level at its western extremity, and at its termination, at Eagle Point, about 85 feet. The latter is a conspicuous feature of the right bank of the Mitchell below Bairnsdale, which arrests the attention of passengers on the Lakes' Entrance steamers. The section from its summit to the river level, as illustrated in Fig. 2, contains the following strata :—

Gravel, with stones up to 5in. in diameter	-	20 feet.
Yellow sand - - - - - - -	-	30 ,,
Coarse cemented sand - - - - -	-	15 ,,
Fine cemented sand and gravel in layers	-	15 ,,
Total		80 feet.

The highest ridges consist almost entirely of sand, while, at a lower elevation of from 150 to 200 feet above sea level, this is mostly replaced by a clayey soil, which, in general, is full of small circular depressions a few feet in diameter, locally termed crab holes. In very wet weather these form almost continuous sheets of water, but in summer they open into cracks which extend downwards for a considerable depth, allowing the water to escape.

At an elevation of about 100 feet above sea level, a lower terrace runs parallel to the river, on which is a soil of the same character as that higher up. Near the limestone banks, especially

at Hillside, inverted conical depressions of considerable area occur, as much as from 200 to 300 feet in diameter and from 50 to 60 feet in depth, such as are common in other limestone districts.

The flats on the banks of the Mitchell vary in width from about two miles at the upper end to less than half a mile at Bairnsdale, where they are confined by limestone cliffs. Their fall follows that of the river, and is approximately 100 feet in about 25 miles. The soil on them consists for the most part of a loose, friable, siliceous material of great depth. In the upper portions of the river, where its fall is greater and the flats are wider, the general slope is from the higher, more distant banks towards the stream; in places where subsidiary channels have formed, the slope is towards them; in flood times it is by the backing up of water in these that portions of the flats are submerged. In the lower portions of the river, the banks now enclosing the channel are much higher than the flats which, in general, fall away from them, and towards the earlier formed, more elevated banks that bound them, so that during floods the actual margins of the river are the last portions to become submerged. The bed of the channel itself was originally confined between banks which were covered with dense vegetation. Above Lindenow the stream at one time consisted of long stretches of deep water and shallow rapids over loose stones. Below Hillside there was one continuous deep channel to the mouth of the river. The present state of the stream is widely different. The river banks have been denuded of vegetation, and broken down in many places by stock, with the result that the loose, friable soil has disappeared by the acre, and a stony gravel bed, sometimes over a hundred yards across, has been exposed; the banks also have been left vertical, to wash farther and farther away with every flood. The lighter material is swept over the lower lands and passes into the lakes, while the heavier material is continually creeping down what was once the deep channel of the river, plugging it up solidily as it goes. This action has gone on until it is now possible to ford the river near Bairnsdale, while in the earlier days the Manaro crossing at the Wuk Wuk village settlement, was the point at which the river was fordable. Below Bairnsdale the river is from 200 to

260 feet in width, the depth of the channel varying from 14 to 30 feet. It is subject, when low, to tidal influences, salt water creeping up as far as the Bairnsdale waterworks, or a distance of from 15 to 16 miles from its mouth. The banks from Bairnsdale down slope on the eastern side towards Jones' Bay, one of the Gippsland Lakes, and on the western side towards McLeod's morass. About a mile below the morass, the current sweeps against Eagle Point, the ridge terminating the watershed; from this point it flows through a tongue of land for nearly five miles, the exact distance between a trig. station on Eagle Point, and another at the present terminus of the land being 7366 yards. This strip of land varies in width on either side from 200 to 2000 feet, the average being less than 1000 feet; on one side it slopes to Jones' Bay, and on the other to Eagle Point Bay. After passing the present landmarks forming its mouth, the river flows in a well defined channel in Lake King for 2100 feet, with an average width of 160 feet, and of depth 10 to 12 feet at low water, the banks being about 2 feet below the surface, except after a heavy flood, when they appear above it. The submerged bank extends for about 1600 feet at right angles to the flow of the river, and at this distance is only from 3 to 4 feet below the surface, deepening in a few yards to 8 or 10 feet, and then gradually to 22 feet, which is the uniform depth of Lake King over some miles. The tongue of land caused by the deposit in Lake King has had the effect of partly closing Jones' Bay, from which the only exit for the waters is a narrow channel leading into the submerged extension of the Mitchell.

The secondary banks separating the flats from the sloping tableland above may be traced from the devonian rocks at Boggy Creek to their termination at Bairnsdale, and again at the isolated bluff at Eagle Point. From Moitun Creek to about a mile below Lindenow township, these banks consist of fine siliceous sedimentary material near their base, and coarse above, with ironstone bands of varying thickness, and more or less fossiliferous. (See sections of Morrison's Bluff and Perry's Bluff, Figs. 8 and 10). Fossiliferous ironstone also crops out in an indentation between Perry's Bluff and Coongulmerang. Thicker bands of clayey ironstone occur in cuttings near Lindenow, and

fossiliferous ironstones on the river banks below the hotel, the State School, and Saunders' house at Lindenow itself. The ironstone and siliceous sediments shortly disappear, and the banks become less steep and slope gradually up to the higher ground. About half a mile from the ironstone outcrops, limestone shews at the foot of the bank and may be traced down to Bairnsdale, rising in places to a height of 100 feet from base to summit.

At Rose Hill, about 3 miles west of Bairnsdale, the limestone is immediately overlain by a deposit of a different character. The bank there is strewn with shells like those at Jemmy's Point, and thus of miocene age. A full description of this interesting bed will be given in the sequel.

On the upper surface of the terraced banks bounding the flats there is usually a heavy gravel wash, cemented in many places with ferruginous material and in some cases coated with manganese oxide. Similar gravel washes occur in the bed of the river, in places on the surface of the flats, and almost invariably below them. They exist also as low ridges on the tableland fully 250 feet above the present bed of the river and with included blocks weighing as much as 60 or 70 lbs. These ridges, no doubt, indicate in general the course of the old streams. They are capped with conglomerate and have worn less than the surrounding softer country. Gravel containing boulders from six to nine inches in diameter is in fact met with at least 20 miles from its source, and over 200 feet above sea level. These drift deposits, which have been extensively used for road making and railway ballasting purposes, are slightly auriferous. Indeed, the gravel washes in some parts of the Mitchell River itself, though many miles from any silurian rock, give payable returns.

The watershed on the north side of the river, so far as tertiary deposits are concerned, includes the country drained by portions of Flaggy Creek, Prospect or Boggy Creek, and Clifton Creek, as well as a few minor gullies. Near Flaggy Creek, where devonian sandstones are exposed, the country rises somewhat suddenly to the north, and thence on to Boggy Creek the river runs almost parallel to the devonian hills, and at no great distance from them. The highest eminence is Mount Taylor where devonian strata, about 400 feet in thickness, and composed of sandstones, conglomerates, and shales, rest on porphyritic rock, the upper surface

of which is over 1000 feet above the level of the creek below. Another elevated porphyritic peak, known as Granite Rock, rises a short distance to the north-east of Clifton. This is about 500 feet in height and from its summit a magnificent panoramic view of the surrounding country is presented. Between these two hills the auriferous silurian rock crops out. A series of sandy ridges, evidently of marine origin, occupies the surface from the southern flanks of the hills to the Mitchell River, the general fall of the country being in the same direction. Boulders of sandy ironstone occur here and there on the ridges, but none of those collected from a greater elevation than 200 feet above sea level contained fossil casts.

On the lower terraces the soil, which has been derived from the calciferous rock below, or from the decomposed ironstones, is fairly fertile. The upper sandy ridges are heavily timbered with eucalypts. The gravel terraces, though much less extensive on this side of the river than on the other, yet show in nearly all the sections exposed in gullies or road cuttings. On the banks of Boggy Creek, which has cut its way through some hundreds of feet of porphyritic rock, the auriferous terraces extend for over 120 feet above the present bed of the stream. Owing to the considerable mining operations formerly carried on in this creek, the bed in the lower portion of its course has become silted up, and the heavy sand is now filling the Mitchell. It is intereeting to note that by the combined action of Boggy Creek and the Mitchell River an isolated strip of calciferous rock has been left in the midst of an extensive flat. The next gully, Drevermann's, commences at Mount Lookout, and has been formed by a stream which has cut its way through the sandy drifts as far as Knight's house, on the Wuk Wuk road, and thence through the Bairnsdale limestones to the Mitchell. The only other stream of importance is Clifton Creek, which drains the silurian, devonian, and porphyritic hills to the north. After passing Hamilton's house it flows through a wide flat, thence through Boyd's, where it is bounded by silurian strata on the west, and the sand drifts and porphyritic rock on the east, and finally passes into Clifton morass. This is about two miles in length, and tapers from a mile in width at the upper end to a narrow channel at the lower. A big flood, which occurred about ten years ago, cut a channel

some thirty feet deep, through the morass, or, as it may more properly be called, peat bog, and it has since slowly drained. The surface has, in consequence, become cracked and fissured in all directions, and a subsidence of several feet has taken place. Fires lit on it have burnt in all weathers for years. After burning, the ash, incorporated with the peaty material below, forms a fair soil. The whole of this peat morass appears to have resulted from the decay of small vegetation, as it contains no timber of any size.

The limestone beds can be traced for a few hundred yards above Mr. Hope's house on the eastern side and also on the opposite bank, but higher up still only the sandy drifts appear. The morass empties itself into the Backwater, a channel of the Mitchell, which flows southward for about a mile between well defined limestone rises, then turns eastward along the limestone cliffs on the northern bank of the Mitchell, and finally joins the main stream near the Bairnsdale bridge.

From Glenaladale until just below the Lindenow bridge, the vertical sections exposed on the northern banks, show sandstone and massive conglomerate beds, which rise into rounded hills of devonian sandstones. The river flats thus lie for this distance between tertiary and devonian strata. The latter probably occur at no great depth below the Woodlands and Glenaladale properties; indeed, only a few yards above the Lindenow bridge, devonian sandstone outcrops on the flat itself.

A short distance below this point, Flaggy Creek enters the river and has exposed a fine section known as Saunders' Bluff, which will be fully described later on. Another small stream comes in about half a mile lower down, and has cut through a heavy cemented compact gravel wash which reappears as far down as Skinner's. About a mile below Saunders' Bluff there is a fossiliferous section which continues for a few hundred yards, and terminates at Skinner's, the best known collecting ground for eocene fossils on the river. At the base of this section are the calcareous beds, which are overlain by a yellow, soft fossiliferous ironstone, and this in turn is covered with sandy drift and occasional ironstone boulders. Below Skinner's, only rounded hills of the ironstone deposit are observed until the Manaro crossing or Wuk Wuk village settlement is reached. Here

again the soft fossiliferous ironstones are in evidence, and underneath them lie the compact Bairnsdale limestones. Another stretch of rounded banks extends as far as Myrtle Point, where on one side of a small gully ironstone outcrops are alone visible, while on the other a fine vertical face of calciferous rock stands out boldly. The limestone continues for some distance, and is then succeeded by rounded ironstone hills, which are traceable across Boggy Creeek, to near its junction with the Mitchell. A fine section here leads on to Dreir's, where a clayey bed, containing numerous fossils similar to those at Skinner's, extends for about 30 feet up from the water's edge, when it is sharply cut off from the tall calciferous cliff above by a shelly layer. The hard limestone rock can then be followed round the bends of the river to Captain Underwood's, almost opposite Rose Hill, where it is overlain by ironstone deposits containing numerous casts of miocene fossils. The continuation of the calciferous rock from this point to the Backwater of the Mitchell, has already been noticed.

The various sections on the river banks from which fossils have been obtained will now be described in detail.

III.—Rose Hill.

The Mitchell from Boggy Creek to Dreir's has a fairly straight course a little south of east, but then bends round and forms an extensive loop as far as Underwood's (see map). The Rose Hill section is at the western corner of the loop, and on the right bank of the river. Thence going east for some distance the stream turns north just behind the B.R.C. Hotel, but takes a westerly direction near Radford's house, until after passing the Bairnsdale Water Supply works, it again flows north towards Underwood's on the opposite bank.

Our attention was first drawn to this locality by noticing that the limestone underlying the upper rounded banks showed an unmistakable dip, and it was thus evident that an unconformity existed. We expected to find merely an ironstone deposit similar to that at Bellevue, on the other side of the river, which we had formerly examined pretty thoroughly. A search on the hills and gullies near the hotel, and thence westerly along the terrace

bounding Smith's flat, showed that ironstone outcrops containing occasional casts of miocene fossils are present, but at Rose Hill section itself these give place to calcareous clays containing unaltered miocene shells, which recall the rich fossiliferous beds at Jemmy's Point, Lake Bunga, and other places on the Gippsland Lakes. Individual examples of some species are very common, amongst which may be mentioned, Chione subroborata, C. propinqua, Tylospira coronata, Trigonia acuticostata, Ostrea arenicola, Olivella nymphalis, Turritella tristira, Tellina aequilatera, Corbula ephamilla. In all 85 species were collected, a list of which is given below. Immediately underlying the miocene marls there is the typical eocene limestone of the area, which was here evidently an eroded surface when the later beds were deposited upon it. The full section (Fig. 3) from the summit of the terrace to the flat level is:—

Clay - - - - - - - - -	7 feet.
Conglomerate, with ferruginous cement - -	10 „
Clay - - - - - - - - -	10 „
Clay and soft limestone, with miocene shells -	10 „
Marls with miocene shells - - - - -	8 „
Nodules of limestone, with eocene shells -	20 „
Calciferous rock, with eocene fossils - -	4 „
Limestone - - - - - - - -	6 „
Total - - -	75 feet.

The eocene limestones continuously outcrop at the base of the hills bounding the loop, except where the river trends northerly, or between the B.R.C. Hotel and Radford's. For this distance only stratified drift is to be seen, whence it may be inferred that a channel of considerable width was there cut through the eroded limestone. Possibly the channel extended across in the direction of McLeod's morass.

Fossils from Rose Hill.

Ringicula tatei, Cossmann
Bullinella cuneopsis, Cossmann
Bullinella aratula, Cossmann
Terebra sp.*
Conus sp. (much worn)
Bathytoma pritchardi, Tate
Bathytoma sp.*
Bathytoma, n. sp.*
Pleurotoma, n. sp.
Surcula sp.*

Drillia sp.*
Drillia sp.*
Drillia sp.*
Drillia sp.*
Cancellaria sp.*
Ancilla orycta, Tate
Olivella nymphalis, Tate
Marginella propinqua, Tate
Marginella sp.*
Voluta sp. (much worn)
Uromitra euglypha, Tate
Fusus gippslandicus, Tate
Fasciolaria (?) sp.*
Fasciolaria (?) sp.
Latirus purpuroides, Tate
Phos gregsoni, Tate
Lampusia, sp.*
Lampusia, n. sp.
Tylospira coronata, Tate
Cypraea sp. (fragment)
Cerithium (?) sp.
Cerithium (?) sp.
Turritella murrayana, Tate
Turritella conspicabilis, Tate
Turritella tristira, Tate
Turritella acricula, Tate
Rissoia sp.
Crepidula unguiformis, Lam.
Calyptraea crassa, Tate
Natica subinfundibulum, Tate
Natica polita, T. Woods
Natica hamiltonensis, T. Woods
Natica cunninghamensis, Harris
Natica subvarians, Tate
Eulima, n. sp.*
Niso psila, T. Woods
Odontostomia sp. (fragment)
Trochus (?) sp.*
Calliostoma sp.
Dentalium largicrescens, Tate
Ostrea arenicola, Tate
Placunanomia ione, Tate
Spondylus, n. sp.
Limea, n. sp.
Pecten antiaustralis, Tate (juv.)
Cucullaea corioensis, McCoy
Limopsis forskali, A. Adams
Glycimeris laticostata, Q. and G.
Nucula antipodum, Hanley
Leda vagans, Tate
Leda woodsii, Tate
Trigonia acuticostata, McCoy
Cardita spinulosa, Tate
Cardita, n. sp.*
Crassatellites oblonga, T. Woods var.
Kellia micans, Tate
Cardium sp.
Meretrix paucirugata, Tate
Meretrix, n. sp.
Chione cognata, Pritchard
Chione subroborata, Tate
Chione propinqua, T. Woods
Chione allporti, T. Woods
Dosinia sp., *aff.* D. johnstoni†
Tapes, n. sp.*
Zenatiopsis angustata, Tate
Corbula scaphoides, Hinds
Corbula ephamilla, Tate
Panopaea australis, Sow.
Barnea tiara, Tate
Tellina aequilatera, Tate
Tellina albinelloides, Tate (?)
Cuspidaria, n. sp.
Aspergillum sp.
Trematotrochus clarkii, Dennant

IV.—Bellevue.

The ironstone conglomerates of this section were examined several years ago, and before the Rose Hill bed on the opposite bank was discovered. It is situated about two miles from Bairnsdale and immediately on the terrace bank of the river. Many visits have been paid to the locality, and we have to thank Captain Underwood, who owns the farm, for valuable assistance in the researches made. The ironstone is fresh looking, and the fossil casts in it are exceptionally sharp and distinct. We broke

* Also in the Gippsland Lakes miocene.
† Also at Table Cape.

up a very large quantity of the material and were able to identifiy the species named below. We may state here, that in the identification of these and all other fossils from an ironstone matrix mentioned in the present paper, we availed ourselves of the critical knowledge of tertiary mollusca possessed by the late Professor Tate—in fact, the several lists offered of ironstone fossils from Bellevue, Moitun Creek, Village Settlement, and Lindenow, were drawn up in consultation with him. For the most part, moulds in wax have been prepared, which can be consulted whenever occasion arises.

Fossils from Bellevue.

Roxania, sp.
Nassa sublirella, Tate
Phos gregsoni, Tate
Lampusia, n. sp.*
Tylospira clathrata, Tate
Turritella tristira, Tate
Turritella acricula, Tate
Natica cunninghamensis, Harris
Leiopyrga quadrisulcata, Tate
Calliostoma, sp.*
Modiola, two spp.
Modiola, sp.†
Glycimeris laticostata, Q. and G.
Cucullaea corioensis, McCoy
Leda woodsii, Tate
Trigonia howitti, McCoy
Trigonia acuticostata, McCoy
Crassatellites oblonga, T. Woods
Chione propinqua, T. Woods
Chione subroborata, Tate
Meretrix, sp.
Dosinia johnstoni, Tate
Mactra axiniformis, Tate
Corbula ephamilla, Tate
Zenatiopsis angustata, Tate
Tellina albinelloides, Tate
Myadora corrugata, Tate
Lunulites rutella, T. Woods
Lovenia forbesi, T. Woods

One of the ironstone blocks containing several marine fossil casts, shews also a well preserved leaf impression (species undetermined), and it is evident therefore, that the deposit was a strictly littoral one.

The most frequently recurring species are Trigonia howitti, Chione propinqua, Zenatiopsis angustata, Leda woodsii, Leiopyrga quadricingulata, and Lovenia forbesi. Less common, but still tolerably abundant, are Chione subroborata, Tylospira clathrata, Turritella acricula. The remainder are, as a rule, represented in our gatherings by single specimens only. With few exceptions, the same species are abundant throughout the calcareous beds of the Gippsland miocene as well as in equivalent strata at Rose Hill.

* Also in the Gippsland Lakes miocene.

† Also at Spring Creek.

The Bellevue bank, as measured by levelling from Captain Underwood's doorstep, is 146 feet above the river level. (See Figs. 4 and 5 for sections at Bellevue). A section exposed on the face of the cliff overlooking the river gives :—

Ferruginous blocks, with miocene fossils -	14 feet.
Clay - - - - - - - - -	4 "
Limestones (eocene), with fine gravel - -	10 "
Yellow limestone (burnt for lime) - -	4 "
Alternate beds of hard and clayey limestone, with eocene fossils - - - - -	70 "
Talus to river level - - - - - -	30 "
Total	140 feet.

A little back from the cliff and on the slightly sloping bank, a heavy gravel wash shows in a quarry, referred to below, and then farther up still a ferruginous sandy conglomerate. The fall of the river from Underwood's down is very slight, the surface of the water at the section quoted, being only six feet above sea level.

There is a deep gully close to the house, and a section across it is given in Fig. 4. On both sides the hard calciferous limestone can be seen outcropping here and there among the grass, until towards the summit the overlying fossiliferous ironstone and heavy gravel wash successively appear.

The quarry shown in Figs. 4 and 5 was excavated to obtain gravel for road making, and at its base a portion of a fossilized tree three feet long, and two feet in diameter, was uncovered. The log has not been removed, and was thus seen by us *in situ*. It is coated all round with ferruginous gravelly material to a thickness of some inches, while the internal part consists largely of decayed vegetable matter. The top of the quarry which is 13 feet below Bellevue House, and therefore 139 feet above sea level, represents nearly the highest point at which miocene casts were obtained. The house is built on the river terrace and not on the summit of the bank, which is reached by a gradual slope at a further height of 105 feet. The strata consist mainly of gravels, sands, and clays, with here and there ironstone blocks enclosing pebbles, but apparently unfossiliferous. The same remark applies to ironstone at Clifton, near at hand, and also to

scattered surface blocks at a much higher level on the Bulumwaal road.

The pebbly drift in the Bellevue quarry is very coarse, and on one side fully 12 feet thick. Many of the larger stones lying on the floor are lenticular in shape, and as much as a foot in length, by eight to nine inches in breadth. On the face of the quarry the stones are of various sizes, and the larger ones mentioned have probably been rejected when the material was carted for road making.

At first sight it might easily be supposed that the pebble drift is interstratified with the fossiliferous ironstone, as it crops out not only at a higher, but also at a lower elevation even in contiguous exposures. In the quarry some few blocks apparently overlie gravel, but this we think is due to slipping. After protracted observation and much consideration, we decide that the gravel drift is younger than the fossiliferous miocene ironstone. Reference to Figs. 4 and 5 will shew our interpretation of the evidence presented at Bellevue.

As before mentioned, the gravel is wide spread, and is especially displayed in road cuttings south of the river, between Bairnsdale and Lindenow. At the latter locality the river is fordable in summer, and, though a large volume of water is always flowing, the greater part of the channel, which is sometimes 300 to 400 feet in width, becomes dry. A large extent of the river bed is thus exposed, and consists entirely of loose stones like those at Bellevue. Similarly at Bairnsdale the gravel is abundant, and has been freely used in making the roads of the shire. On the north of the river the gravel deposits, though fairly thick in places, are less extensive than those on the south side. At Underwood's, as we have seen, and also in a cutting in Dreir's lane, much gravel is present. Again, there is a heavy conglomerate, 10 feet thick, at Skinner's, and another towards Saunders' Bluff, both being terrace deposits.

The origin of the gravel drift is not in doubt. It is clearly derived from the waste of the devonian, silurian, and porphyritic rocks to the north. The majority of the pebbles consist of sandstone, but among them are fragments of porphyry and quartz. Though much weathered, the larger porphyritic pebbles, when fractured, sometimes reveal an internal core of scarcely altered

rock. From Lindenow on to the west, devonian rock masses may still be seen *in situ* in the river bed and together with their associated porphyries they no doubt formed the coast line during the deposition of the earlier tertiaries from Lindenow to Moitun Creek. These ancient rocks, however, are at a considerable distance from Bairnsdale and Bellevue, so that the gravels there must have been brought down by the river itself or by other streams from the north. As we shall presently shew, there is undoubted evidence of drifts due to coast action at Moitun Creek, Lucas Creek, etc., but the coarser and far more widely spread gravels now under consideration have, we think, been largely transported by running water.

The relation of the gravels to the miocene ironstone has been chiefly studied at Bellevue, where alone the contact of the two deposits is well displayed, and the following extracts from notes taken on the spot will explain our views upon the somewhat complex problem presented.

The gravel appears to be merely a terrace deposit due to an old stream. It is too coarse for simply marine wash, being so far removed from its source. It can be traced westward for some distance, and since it does not extend laterally into the hill, it clearly represents a channel cut throngh the old miocene bed. Reference to Fig. 5 shews that in the quarry gravel occurs at a lower elevation than an exposure of the fossiliferous ironstone, but this is explained by supposing that the drift has cut away portions of the bed and has left blocks of ironstone, which now protrude here and there, through the gravel. Though in places at a higher level than the latter they are the older strata. On levelling across from the quarry to Underwood's garden the fossiliferous blocks were met with at the same elevation; the gravel is above, while beneath there is no gravel, but only clay and ironstone. A flag-post hole was lately sunk in front of the house to a depth of six feet through this gravel, so that the latter is there on the top. It may be added, also, that, though occasional loose blocks of fossiliferous ironstone are found comparatively high up on the banks, the gravel invariably shews higher still.

The precise age of the gravel drifts is doubtful. So far as the evidence goes they may be of any age from pliocene to recent. They are probably contemporaneous with the formation of the

river channel, at least in this part of its course. In many places they are left high up on the banks of the river, which has since cut its channel deeper and deeper into the underlying limestone. Frequently they have been redistributed, and, as at Lindenow, now rest in the actual bed of the stream.

Next in order to the irônstone conglomerate come the well known Bairnsdale limestones. They are of unknown thickness here, but terminate abruptly as the river is followed up. They may be briefly described as hard compact rocks, rich in fossils, which, however, with the exception of a few species of pectens, a large oyster, several brachiopods, and occasional examples of other forms occur as calciferous casts only. Lists of the species recognised in various outcrops of the strata have been previously given (4 and 6), and need not be now repeated. For miles along the Mitchell as well as on the Nicholson and Tambo Rivers, at Lake Tyers, and as far east as Snowy River, the same eòcene rocks are presented. At Bellevue the upper portion of the limestone for several feet down shews numerous very small siliceous pebbles, with here and there a larger one scattered irregularly through it. All of them are ironstained, much rounded, and worn. We have not observed similar pebbles in exposures of the rock elsewhere. There is no question here of a remade bed, the junction of the two strata, viz., eocene and miocene being sharply defined. Both are apparently horizontal, and thus comformable. Still the exposure in the upper deposit is too small to allow of a positive statement under this head.

V.—Knights.

On the Wy Yung road, north of the Mitchell, and between Bairnsdale and the section just described, a small road cutting displays a similar ferruginous conglomerate, but the fossil casts, owing to the prolonged weathering of the material, are usually indistinct, Trigonia howitti and Myadora corrugata being the only ones we could definitely name. Under the ironstone a moderately stiff clay, containing from 40 to 50 per cent. of coarse waterworn sand, reaches down to the road level. The junction line of the two strata is uneven, slight hollows in the sands and clays being filled by the ironstone. As the latter continues on the hilly ground beyond the top of the cutting, its thickness could

not be accurately estimated. The cutting itself is about 145 feet above sea level, or at the same height as the Bellevue section. Isolated boulders of fossiliferous ironstone can also be traced in the neighbourhood of this cutting for a further height of 15 feet. There is no gravel associated with the ironstone here. From Knight's to Bairnsdale the country falls, and the eocene limestone outcrops on the river banks with pebble drift resting immediately upon it.

In a former paper (6) we traced the northern boundary line of the Gippsland miocene from Red Bluff to the Nicholson River, but the discovery of the ironstone casts at Knight's and Bellevue, as well as of unaltered miocene shells at Rose Hill permits of the continuation of this line for at least eight miles farther west. Between Knight's cutting and the Nicholson the miocene has not been observed, but its existence in portions of the area immediately north of Bairnsdale is not improbable.

In geographical order going up the river from Bellevue, the section at Drier's comes next, but as in one important respect this resembles Skinner's, it will be described in conjunction with the latter, and we pass on to

VI.—Boggy Creek.

On the Government maps this stream is now noted as Prospect Creek, but we retain the old name for the sake of reference to earlier descriptions. It empties into the river through a wide flat. In summer the actual channel is narrow, and confined to the eastern margin of the flat. At the southern end and abutting on the river there is a fine cliff of eocene limestone 194 feet in height above datum line (sea level), and very steep, a fact which was forcibly impressed on our minds when climbing it on a very hot day. The bank bordering the flat on the eastern side is much lower, rounded, and with a more gradual slope; it continues for about three quarters of a mile, and encloses a kind of amphitheatre reaching up to the road. Where the traffic bridge crosses the creek, the flat narrows abruptly, but widens out again on the north. On both sides of the creek the ascent to the general level of the country is steep; by actual levelling the highest part of the road, near Dooley's gate on the western slope, was found to be 230 feet above datum line.

At the summit of the limestone cliff overlooking the river we found no ironstone. The rounded banks of the creek farther from its mouth are covered with soil, but here and there the limestone crops out, or shews in wombat holes round the base of the hill up to the bridge. In addition, there are numerous boulders of sandy ironstone containing very distinctly marked fossil casts. These boulders continue from near the creek level almost to the top of all the hills in the amphitheatre, with the exception of the tall cliff at the extreme south. When we first saw the ironstone boulders we somewhat hastily concluded that they contained miocene fossils similar to those gathered at Bellevue, and we commenced to break them up in order to enrich our collection. To our surprise, however, we obtained instead a typical eocene fauna, as will be seen from the following list of species determined:—

FOSSILS FROM BOGGY CREEK.

Bullinella, sp.
Roxania woodsii, Tate
Conus, sp.
Volutilithes antiscalaris, McCoy
Voluta maccoyii, T. Woods
Fasciolaria sp.
Latirus murrayanus, Tate
Lampusia woodsii, Tate
Lampusia annectans, Tate
Apollo prattii, T. Woods
Semicassis transenna, Tate
Cypraea, two spp.
Potamides semicostatum, Tate
Turritella murrayana, Tate
Turritella tristira, Tate
Natica, sp.
Emarginula wannonensis, Harris
Dentalium mantelli, Zittel
Spondylus pseudoradula, McCoy
Hinnites corioensis, McCoy (prob.)
Pecten murrayanus, Tate
Modiola pueblensis, Pritchard
Glycimeris laticostata, Q. and G.
Limopsis forskali, Adams
Cucullaea corioensis, McCoy
Cardita polynema, Tate
Cardium victoriae, Tate
Meretrix submultistriata, Tate
Chione dimorphophylla, Tate
Mactra howchiniana, Tate
Panopaea orbita, Hutton
Cuspidaria subrostrata, Tate
Magasella woodsiana, Tate
Flabellum gambierense, Duncan
Flabellum victoriae, Duncan
Placotrochus deltoideus, Duncan

These fossils, or at least nearly all of them, are also common in the prolific shell beds at Skinner's and Drier's (see post), which we regard as on the same geological horizon as the Bairnsdale limestone, the relative abundance of certain fossils in the two sets of strata being chiefly due to altered sedimentary conditions. Further reference to this matter will be made later on. At Boggy Creek both strata are represented, the first by the fossiliferous ironstone, and the second by the adjoining calciferous rock.

Amongst the ironstone strata of the amphitheatre banks, we picked up several unaltered oyster shells similar to those in the river cliffs. In occasional blocks, also, we found that the substitution of the iron oxide for limestone was partial and confined to the outer portions of the stone. Specimens from the latter have not been quoted in the list, but only those which occurred as casts in fully altered rocks. For the most part, the nodules of fossiliferous ironstone crop out at a comparatively low level, but some resting on the tops of the rounded hills bordering the flat, and others still higher up on the eastern slope of the road yielded, when broken, good fossil casts.

Besides the exposure of the limestone on the southern cliff and at the base of the low hills along the creek, there is a small inlier on the roadside at the eastern approach to the bridge. This has been quarried and a face about 35 feet high is left (see Sec. Fig. 6). The rock here is much weathered and also hardened superficially by redeposit of calcium carbonate, but a few shells were detected in it, viz., Spondylus gaederopoides, Pecten yahlensis, and P. gambierensis.

The full section at the quarry is :—

Surface soil - - - - - - - -	6 feet.
Clay - - - - - - - - - -	8 „
Projecting limestone layer, coated with ironstone, and containing calciferous casts of fossils - - - - - - -	2 „
Fine sand and efflorescing salts - - -	10 „
Nodules of limestone and silt, with very small worn quartz pebbles - - -	9 „
Total	35 feet.

The hill on the west side of the creek leading up to, and beyond Dooley's gate, is a counterpart of that on the other side, except that no limestone is visible at the base. Section Fig. 6, shews the strata on the western ascent, the steepness being, to save space, greatly exaggerated. The alternating layers of drift and soft ironstone bands occur up to the summit. The summit itself, is capped with the bed of an old stream, the bottom of the channel being well defined; the silt has been cut into, and

the pebbles and stones are cemented together, giving a hard conglomerate cap which has weathered less than the surrounding softer material. The fine drift sand on this side suggests sedimentation from a river current, which emptied into the eocene sea, near the present mouth of Boggy Creek. The sediments are of course marine, and practically contemporaneous with the deposition of the limestone on the eastern bank.

A short distance up the western rise from Boggy Creek, and just before reaching Dooley's gate, there is a road cutting, in which a thickness of 8 or 10 feet of massive ironstone is exposed. Its elevation is 160 feet above sea level, and, though unpromising looking for fossils, we ultimately found a layer shewing numerous casts, amongst which we identified the following species :—

Conus sp.	Glycimeris laticostata
Lampusia sp.	Cardium sp.
Spondylus gaederopoides	Magellania insolita
Pecten foulcheri	Echinoderm (spine)
Pecten gambierensis	Placotrochus deltoideus

These fossils of course stamp the outcrop as eocene, which thus extends upwards at Boggy Creek, and does not give place in the higher levels to the Bellevue miocene. Again, on the southern cliff, at the mouth of the Creek, which is 194 feet above datum line, and thus fully 40 feet higher than Bellevue, the topmost strata are still eocene. In fact, after leaving Underwood's, we found no further trace of the miocene westward, though we made most diligent search.

At Myrtle Point, about a mile further west, we again struck the river. Ironstone is here abundant just below the summit of the cliffs as well as in places down the bank. Many boulders were broken up but the fossil casts were rare and mostly indistinct; we identified only Magellania insolita, and Cardita delicatula from this outcrop. In many blocks we noticed very small fragments of decayed wood.

Before leaving the Boggy Creek Section we remark that the fossils obtained by Mr. Howitt in his researches in this area were submitted to Sir F. McCoy, who classed those from the ironstones of Boggy Creek and Moituu Creek as upper miocene or lower pliocene, and younger than the Bairnsdale limestones, which he placed in the middle miocene (1). The distinction in age thus drawn between the calciferous and ferruginous beds at

Boggy Creek is, as we have indicated, an error. There is no break in the series, both sets of strata, though differing lithologically, being on the same geological horizon. According to the views now current concerning the age of the Australian tertiaries, the deposits are classed as eocene and not miocene.

VII.—Moitun Creek.

This, the extreme westerly section examined, is the most typical one from which ironstone casts belonging to the older group of the Mitchell tertiaries have been obtained. As already stated, Moitun Creek enters the Mitchell River just at its great eastern bend. At this junction the river flat is 108 feet above sea level. A fine section here (Fig. 7) shews towards its base hard yellow sandstone and then sand and drift with fossiliferous ironstone in layers up to a height of 113 feet. Resting upon the topmost ironstone layer there is about 17 feet of gravel wash, with stones in it as much as 6 inches in diameter. The summit of the cliff is 140 feet above the river, but the country still rises and heavy gravel washes may be traced up to a height of 200 feet. Our chief collecting ground was not at the junction, but about half a mile west, on the south bank of Moitun Creek. A section at Morrison's Bluff, which rises steeply from the margin of the creek (Fig. 8), reads thus :—

Surface soil and gravel - - - - -	25 feet.
Massive conglomerate - - - - - -	5 „
Ironstone layers, with fossils and sandy drift	9 „
Pebbly gravel - - - - - - -	5 „
Yellow sandy clay - - - - - -	6 „
Ironstone, highly fossiliferous - . -	2 „
Pebbly cemented gravel - - - -	8 „
Fine yellow sand, with ferruginous pipes and talus - - - - - - - -	50 „
Total	110 feet.

A few chains further west, and close to the road over Moitun Creek, leading to Iguana Creek, the tertiaries rest directly on

devonian shales, the sequence of the strata from the creek bed to the level of Morrison's house being :—

Gravel and clay - - - - - - -	35 feet	
Ironstone bands, with fossils - - -	27 „	
Devonian shales - - - - - - -	48 „	
Total	110 feet.	

These measurements are only up to the terrace bank on which the house stands. The hill, still shewing drifts and gravel washes, continues by a gradual slope up to Morrison's gate on the main road, where an elevation of 250 feet above the river was recorded.

A longitudinal section at the actual contact of the tertiary and devonian strata is given in Fig. 9. Three bands of fossiliferous ironstone, interstratified with sands and gravels, occur in a vertical height of 48 feet. Both in Morrison's Bluff and at the contact section, fossil casts were collected from near the base up to the summit of the terrace; the most prolific ironstone bands were, perhaps, one just under the terrace level and another adjoining the contact section. The blocks collected are full of fossils and a great variety of species is represented. On the whole, the casts are inferior in clearness to those at Boggy Creek, and a larger quantity of material was broken up to obtain examples which could be definitely named. Impressions in wax or plaster were taken in almost every case.

Fossils from Moitun Creek.

Actaeon scrobiculatus, T. Woods
Scaphander tenuis, Harris
Bullinella exigua, T. Woods
Mangilia (?) sp.
Marginella winteri, Tate
Marginella woodsii, Tate
Marginella sp.
Volutilithes antiscalaris, McCoy (?)
Fusus dictyotis, Tate (prob.)
Latirus sp.
Trophon sp.
Tritonofusus sp.
Typhis evaricosus, Tate
Lampusia tortirostris, Tate
Turritella tristira, Tate
Turritella murrayana, Tate
Rissoia vel Rissoina sp.
Calyptropsis turbinata, T. Woods
Natica polita, T. Woods
Natica vixumbilicata, T. Woods (?)
Eulima sp.
Cantharidus sp.
Dentalium sp.
Glycimeris cainozoica, T. Woods
Glycimeris laticostata, Q. and G.
Limopsis morningtonensis, Pritchard
Cucullaea corioensis, McCoy
Nucula tenisoni, Pritchard
Leda woodsii, Tate
Cardita compacta, Tate (?)

Cardium victoriae, Tate (?)
Panopaea orbita, Hutton
Meretrix eburnea, Tate (?)
Chione allporti, T. Woods
Chione etheridgei, Pritchard
Chione propinqua, T. Woods
Chione, n. sp. (also at Skinner's)
Chione cainozoica, T. Woods
Dosinia densilineata, Pritchard
Psammobia aequalis, Tate (?)
Zenatiopsis angustata, Tate
Corbula ephamilla, Tate
Sphenotrochus emarciatus, Duncan
Deltocyathus viola, Duncan (?)
Deltocyathus (?) sp.

A comparison of this list with that given for Boggy Creek shows some variation in the species represented. This is doubtless owing to the more littoral character of the Moitun Creek deposit. Its fauna is apparently allied to that at Table Cape, on the north coast of Tasmania, which is admittedly a strictly littoral one.

The outcrops of the fossiliferous ironstone at Moitun Creek are confined to the steep southern bank: beyond the flats on the north the strata consist of the devonian sandstones and conglomerates, which continue up to Iguana Creek, the weir on the Mitchell, and thence for a long way northwards. It is especially important to note that there is no limestone at Moitun Creek, nor indeed for several miles to the east to it; the actual limits of this rock on the Mitchell will be indicated directly.

At the mouth of Lucas Creek, which is about two miles east in a direct line from the Moitun Creek junction, there is a bold cliff on the Mitchell called Perry's Bluff. The sediments are mostly very fine, and often almost a pipe clay. The strata are horizontal, and from the surface downwards consist of:—

		Ft.	In.
Ironstone	- - - - - - - -	6	0
Heavy gravel wash	- - - - -	15	0
Ironstone band	- - - - about	4	0
Sandy cement, with ironstone pipes	- -	40	0
Layers of ironstone	- - - about	3	0
Sandy cement	- - - - -	5	0
Ironstone pipes (basic sulphate of iron, efflorescent)	- - - - - -	2 to 3	0
Cemented fine sand, highly coloured	- -	15	0
Ferruginous pipy layers	- - - - - -	0	9
Very fine cemented sandy material	- - -	6	0
	Total—about	97	9

The cliff itself is almost vertical but above it the ground slopes gradually and shews 20 feet of sand to the hill top. Details of this section are also given in Fig. 10. There are innumerable casts of small shells right through the sandy drift material, but they cannot be identified.

It is seen from the several sections in the neighbourhood of Moitun Creek that the strata exposed consist of fine sediments, with which layers of fossiliferous ironstone, and also heavy gravel washes are interstratified. Since the shore line here during the deposition of the eocene was evidently formed of the devonian strata, the drifts and conglomerates may in some measure be accounted for by coastal action. They must, however, be mainly due to mountain streams, including the Mitchell itself, which brought down both fine and coarse sediments and distributed them near the confines of the subsiding sea. The Mitchell River in eocene times probably discharged near Moitun Creek and the sediments which came down are represented by the silts and gravels constantly disclosed in the river sections. The ironstone forms only a small proportion of the total material in the cliffs. Not only the ironstone, but also the cemented sandy drifts are sometimes fossiliferous and we may conclude that in part, at least, they are altered representatives of shell beds similar to those at Dreir's and Skinner's.

With regard to the more elevated sands and gravels displayed in the same sections fossil evidence for the determination of their age is so far wanting. They rise by a gentle slope from the main terrace on the south bank of the river up to the general level of the country.

VIII.—Dreir's.

Reference to the map (Fig. 1.) will shew that this section is situated about midway between Bellevue and Boggy Creek. It consists of a thickness of 70 feet of typical Bairnsdale limestones at the top and beneath them 30 feet of calcareous sands and clays full of well preserved gastropods and lamellibranchs. The two sets of strata are separated by a shelly band. A dip varying from 5° to 10° was noted in the limestone; in most outcrops of such strata on the Mitchell the bedding is horizontal. A sketch of Dreir's cliff is supplied in Fig. 11. The sequence of the

calciferous rock and clays here is notable, since in the contact of equivalent strata on the Moorabool this order is reversed.[1]

Some years ago a fine collection of fossils was made from the lower strata, the names of which we will include with those from a similar deposit at Skinner's, higher up the river. Unfortunately, further collecting at Dreir's is for the present extremely difficult, the outcrop being now almost completely hidden, partly by alluvium and sand washed over it by floods, and partly by the dense undergrowth which afterwards sprung up.

IX.—Village Settlement.

This section is on the north bank of the river, and between Myrtle Point and Skinner's. Some clearly marked fossil casts were extracted from ironstone blocks cropping out on a road leading down to the river, which is here 38 feet above sea level. The lower portion of the bank is occupied by the usual Bairnsdale limestone, and at a height of 50 feet above the river level this gives place to soft fossiliferous ironstone. A short stay sufficed to shew us that the casts resemble those at Boggy Creek, as is indicated by the following examples:—

Fossils from Village Settlement.

Cypraea pyrulata	Glycimeris laticostata, Q. and G.
Turritella, sp.	Limopsis insolita, G. B. Sow. (prob.)
Spondylus gaederopoides, McCoy	Chione, sp.
Spondylus pseudoradula, McCoy	Panopaea orbita, Hutton
Pecten gambierensis, T. Woods, var.	Corbula ephamilla, Tate
Pecten foulcheri, T. Woods	

X.—Skinner's.

Going a little further west we come to Skinner's, where a series of sections extend for about half a mile along the northern bank. Since the silting up at Dreir's, this is now the only locality on the river in which well preserved eocene fossils can be collected; in the ironstone they are, as we have seen, reduced to casts, while in the Bairnsdale limestone unaltered forms are rarely found.

The earliest section worked is at the base of a steep bank directly under Skinner's house. An almost similar section,

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1 Hall and Prichard: Notes on Lower Tertiaries of Southern Portion of Moorabool Valley. R. S. Vic., vol. iv., n.s., 1892.

a few chains farther west, is only accessible on foot when the river is low, but it is, we believe, a more profitable bed for the collector than the other. We reached it in the first instance by means of a duck boat, a mode of conveyance we cannot recommend to geologists, as by some mischance one of us was suddenly tumbled headlong into the river. In addition to the larger forms of mollusca the strata are replete with small shells, corals, bryozoa, foraminifera, etc., which can be easily washed out of the friable matrix. In both sections the shell beds are at the base of the bank and under compact limestone, but in contrast to Dreir's, the latter no longer constitutes the main mass of the strata, alternations of sandy drift and ironstone occurring up to the conglomerate capping at the summit of the terrace. A drawing is given of the more westerly of these sections in Fig. 12, the strata observed being,

SAND AND CLAY ON THE SLOPING GROUND BACK FROM THE TERRACE, AND THEN :—

Massive cemented conglomerate - - -	15 feet
Silt and ironstone bands - - - -	15 „
Sandy drift - - - - - - - -	15 „
Clayey ironstone band, with eocene fossils -	1 „
Sandy drift - - - - - - - -	14 „
Compact limestone - - - - - -	4 „
Fine sandy drift, with ferruginous pipes, similar to the high level beds at Dooley's (Boggy Creek) - - - - - -	9 „
Loose calcareous beds (fossiliferous) - -	13 „
Compact shelly beds down to river level -	9 „
Total	95 feet.

The river here is 46.55 feet above sea level.

At another section, a little farther west still, the strata are much the same, but the basal bed consists of 25 feet of the calcareous material similar to that worked some years ago at the first section, or Skinner's proper, when the majority of the fossils listed below were collected.

In the half mile stretch between Skinner's and the gully, which breaks through the banks westward, many good sections were

noted, but in this short distance they shew a surprising variation in character. This is to some extent the result of alteration since the deposition of the strata, but the chief cause is undoubtedly changes in the sediments. A few hundred yards west of the last section, the calcareous strata disappear entirely at the base and cemented ironstone or only sandy drift occurs for several feet up, while overlying there are nodules and even bands of hard unaltered limestone. A few yards farther west still, i.e., near the gully mentioned, this in its turn disappears. The lower silt is full of the ferruginous pipes and stems common at Dooley's and other sections, and there appear to be also the remains of bryozoa (though on this point we cannot be positive).

We have only recently been able to observe these final sections on Skinner's bank: at previous visits the steepness of the bank and the thick scrub covering it, combined with the approach of the water to the very edge, rendered the place practically inaccessible, but on the last occasion we managed to clamber all over the face.

On the other side of the gully, the massive conglomerate capping and a thickness of 15 to 20 feet of ironstone overlie the sandy drift. This ironstone may be traced westward for about a mile, and is no doubt the same as that which caps Saunders' Bluff. The layers at the base of the latter correspond to those at the west end of Skinner's, about a mile and a half away. Since Saunders' Bluff is practically at the end of the eocene on the north side of the river, the old coast line must have been close to the sections noted, and it is thus fair to conclude that the variation in the strata is mainly due to sedimentation.

We observe that on this side of the river, the limestone at Myrtle Point is of great thickness and constitutes the main mass of the bank, yet at Skinner's section close at hand it is reduced to a thin band. Again, on the south bank, the limestone passes with surprising suddenness into the drift deposits. On the western flank of the Mitchell tertiaries there is thus no gradual thinning out of the limestone, and it cannot, as Mr. Howitt's theory requires, be an eroded basal bed upon which the sandy drifts, with their alternating fossiliferous ironstones, have been subsequently deposited (1). On the contrary, we regard the strata, including the limestone, gastropod beds, and other

sediments, as practically contemporaneous, that is, they belong to the same horizon of the eocene. It is true that both at Dreir's and Skinner's, the calcareous shell beds underlie the Bairnsdale limestone, and must therefore have been first laid down, but at Boggy Creek the ironstones of the amphitheatre, in which similar fossils are now represented by casts, actually overlie the same limestones. Those who have studied the marine tertiaries of Southern Australia, will doubtless recall somewhat analogous occurrences in the eocene of other localities. The relationship of certain well-known calcareous or clay beds, with a rich assemblage of fossils, to adjoining polyzoal limestone has been discussed in various memoirs, and it will suffice to say here that their close palaeontological affinities are now generally recognized. The proximity of the former shore line renders the solution of the problem for the Mitchell sections comparatively easy. The creeks or rivers which discharged into the eocene sea would bring down sands and clays, and a favourable matrix for the preservation of the tests of gastropods, corals, etc., would thus exist, while in the quiet clear waters of areas removed from the action of such currents, the faunal remains might at the same time accumulate as beds of limestone. In the latter, oysters, some species of pectens, echinoderms, etc., are usually more abundant than in the clays, while univalve mollusca are comparatively scarce. The preponderance of certain fossil forms in the respective strata may probably be accounted for by the nature of the enclosing media. Though the large majority remain intact only in the clays and calcareous sediments, a few are certainly best preserved in the limestones. Attention may here be called to Mr. F. W. Harmer's description of the Coralline Crag of Suffolk (England), wherein he states that pectens and other mollusca with calcitic tests, and the remains of bryozoa are common, but the opaque or aragonitic mollusca are represented by casts only[1].

Similar remarks are applicable to the Bairnsdale limestones. In some portions of the latter, as at Swan Reach (5), casts of gastropods, though not plentiful, yet occur, but they are rarely identifiable.

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[1] Q.J.G.S., vol. liv., p. 321.

As already shewn by Messrs. Hall and Pritchard, it is by no means necessary to assume that the limestones of tertiary beds represent deep water deposits.[1] It follows of course from what we have stated that the limestones in this part of the Mitchell area could not have been laid down at any great distance from the shore, and the views expressed by the authors named are thus here of special application.

A list of fossils from Skinner's was given by one of us a few years ago (5), but the present opportunity is taken of adding to as well as of revising it. As before intimated, species from the equivalent bed at Dreir's are now included.

We have to thank Mr. Wallace for the use he allowed us to make of his collection of Skinner's fossils.

Fossils from Skinner's and Dreir's.

Gasteropoda.

Semiactaeon microplocus, Cossmann
Bullinella angustata, T. and C.
Bullinella infundibulata, Cossmann
Bullinella aratula, Cossmann
Bullinella cuneopsis, Cossmann
Umbraculum australe, Harris
Conus pullulescens, T. Woods
Conus cuspidatus, Tate
Conus, sp.
Bathytoma angustifrons, Tate, var.
Columbarium acanthostephes, Tate
Columbarium craspedotus, Tate
Pleurotoma clarae, T. Woods
Pleurotoma murndaliana, T. Woods
Pleurotoma trilirata, Harris
Pleurotoma, n. sp.
Pleurotoma, sp.
Borsonia, sp.
Drillia sandleroides, T. Woods
Drillia stiza, T. Woods
Drillia integra, T. Woods
Drillia, three spp.
Buchozia hemiothone, T. Woods
Cordiera conospira, Tate
Daphnobela gracillima, T. Woods
Mitromorpha daphnelloides, T. Woods
Mitromorpha, two spp.
Clathurella bidens, T. Woods
Clathurella, two spp.
Mangilia, spp.
Cithara, sp.
Cancellaria platypleura, Tate
Cancellaria varicifera, T. Woods
Cancellaria epidromiformis, Tate
Ancilla pseudaustralis, Tate
Marginella wentworthi, T. Woods
Marginella winteri, Tate
Marginella micula, Tate, var.
Marginella, two spp.
Volutilithes antiscalaris, McCoy
Voluta weldii, T. Woods
Voluta maccoyii, T. Woods
Voluta conoidea, Tate
Mitra atractoides, Tate, var.
Uromitra paucicostata, Tate
Uromitra, two n. spp.
Fusus dictyotis, Tate
Fusus senticosus, Tate
Latirofusus exilis, Tate
Fasciolaria, sp.
Latirus salebrosus, Harris
Siphonalia, n. sp.
Phos tardicrescens, Tate
Phos (?) n. sp.
Nassa tatei, T. Woods
Columbella funiculata, T. Woods
Columbella, five spp.
Trophon, sp.
Murex rhysus, Tate
Murex lophoessus, Tate
Murex polyphyllus, T. Woods

[1] Tertiary Deposits of the Aire and Cape Otway. R.S.V., vol. xii., n.s., 1899.

Murex, n. sp.
Lampusia woodsii, Tate
Lampusia tortirostris, Tate
Lampusia gemmulata, Tate
Apollo prattii, T. Woods
Cassis exigua, T. Woods (?)
Cypraea gigas, McCoy
Cypraea leptorhyncha, McCoy
Cypraea eximia, G. B. Sow.
Cypraea parallela, Tate
Cypraea pyrulata, Tate
Trivia avellanoides, McCoy
Triforis wilkinsoni, T. Woods
Triforis sulcata, T. Woods
Triforis, sp.
Cerithium apheles, T. Woods
Colina, two spp.
Newtoniella eusmilia, T. Woods
Newtoniella cribarioides, T. Woods
Newtoniella, eight spp.
Thylacodes conohelix, T. Woods
Tenagodes occlusus, T. Woods
Turritella platyspira, T. Woods
Turritella murrayana, Tate
Turritella tristira, Tate
Turritella acricula, Tate
Torinia, sp.
Rissoia tateana, T. Woods
Rissoia, five spp.
Rissoina, two spp.
Calyptropsis turbinata, T. Woods
Natica hamiltonensis, T. Woods
Natica polita, T. Woods
Natica subinfundibulum, Tate
Scalaria, spp.
Crosseia (?) sp.
Eulima danae, T. Woods
Eulima, two spp.
Niso psila, T. Woods
Pyramidella, n. sp.
Odontostomia, sp.
Eulimella, two spp.
Turbonilla, sp.
Turbo, n. sp.
Collonia parvula, T. Woods
Collonia, sp.
Cantharidus, three spp.
Gibbula, three spp.
Trochocochlea, sp.
Chlorostoma (?) sp.
Calliostoma, three spp.
Astele, two spp.
Euchelus, sp.
Liotia roblini, T. Woods
Tinostoma, sp.
Fissurellidea malleata, Tate
Emarginula wannonensis, Harris
Emarginula, two spp.
Subemarginula occlusa, Tate
Subemarginula, n. sp.

SCAPHOPODA.

Dentalium mantelli, Zittel
Dentalium aratum, Tate
Dentalium lacteolum, Tate

LAMELLIBRANCHIATA.

Ostrea hyotidoidea, Tate
Dimya dissimilis, Tate
Spondylus pseudoradula, McCoy
Lima bassii, T. Woods
Limatula jeffreysiana, Tate
Pecten murrayanus, Tate
Pecten foulcheri, T. Woods
Pecten consobrinus, Tate (?)
Pecten sturtianus, Tate (?)
Amussium zitteli, Hutton
Hinnites corioensis, McCoy
Crenella singularis, Tate
Septifer fenestratus, Tate
Philobrya bernardi, Tate
Plagiarca cainozoica, Tate
Barbatia celleporacea, Tate
Barbatia crustata, Tate
Barbatia simulans, Tate
Cucullaea corioensis, McCoy
Glycimeris cainozoica, T. Woods
Glycimeris laticostata, Q. and G.
Limopsis forskali, A. Adams
Limopsis morningtonensis, Pritchard
Nucula atkinsoni, Johnston
Leda apiculata, Tate
Leda vagans, Tate
Leda obolella, Tate
Trigonia semiundulata, Jenkins.
Trigonia tubulifera, Tate
Cardita delicatula, Tate
Cardita polynema, Tate
Cardita compacta, Tate
Carditella (?) sp.
Mytilicardia, two spp.
Crassatellites dennanti, Tate
Crassatellites communis, Tate
Chama lamellifera, T. Woods

Meretrix, n. sp.
Chione dimorphophylla, Tate
Chione cainozoica, T. Woods
Chione, n. sp.
Mactra howchiniana, Tate
Corbula ephamilla, Tate
Corbula pyxidata, Tate
Panopaea orbita, Hutton
Cuspidaria subrostrata, Tate
Myadora tenuilirata, Tate

PALLIOBRANCHIATA.

Magellania garibaldiana, Davidson
Magellania grandis, T. Woods
Magellania insolita, Tate
Terebratulina scoulari, Tate
Terebratulina sp.
Magasella woodsiana, Tate
Magasella compta, G. B. Sow.

ECHINODERMATA.

Clypeaster gippslandicus, McCoy
Monostychia australis, Laube
Echinolampus sp.
Eupatagus murrayensis, Laube
Astrophyton sp.
Antedon sp.

ACTINOZOA.

Flabellum candeanum, Edw. and H.
Flabellum duncani, T. Woods
Flabellum victoriae, Duncan
Placotrochus deltoideus, Duncan
Sphenotrochus australis, Duncan
Sphenotrochus emarciatus, Duncan
Conocyathus scrobiculatus, Dennant
Deltocyathus viola, Duncan
Trematotrochus fenestratus, T. Woods
Balanophyllia sp. (juv.)

These fossils indicate of course that Skinner's and Dreir's beds are of the type of the Muddy Creek, Murray River, Shelford, Mornington, and some other eocene deposits, and they thus come under Messrs. Hall and Pritchard's division—Balcombian.

A well was sunk for water at Little Brothers' sawmill which lies back from the river about a mile to the north of Skinner's. The surface is 146 feet above sea level and the depth of sinking 92 feet. The strata disclosed are:—

Clay - - - - - - - -	4 feet
Drift, with occasional ironstones containing Magellania garibaldiana and other eocene fossils - - - - -	66 ,,
Calcareous sands, with numerous casts of shells	22 ,,
Total	92 feet.

At this depth brackish water was struck.

XI.—Saunders' Bluff.

That this bluff marks the last appearance of the tertiaries on the north bank of the river has already been alluded to. Farther west this bank is entirely occupied by devonian rocks and the river channel from Moitun Creek to Flaggy Creek thus outlines the boundaries of the two formations: the present stream flows now on one side of the flats and then on the other, the gorge itself being from two to three miles wide.

The river turns south east at Moitun Creek, and then, as we have seen, flows for some miles along the line of junction between unconformable strata. This would probably be the easiest course for the river to take, and its initial deflection to the east at Moitun Creek may have been thus determined.

Saunders' Bluff is 150 feet high, and up to the top of the ironstone, or for 110 feet, it stands out as a bold cliff on the river bank. The strata consist of:—

Sand - - - - - - - - -	40 feet
Fossiliferous ironstone - - - - -	20 ,,
Coloured and banded drift, and pebbles - -	84 ,,
Ferruginous soft red sandstone to river level -	6 ,,
Total	150 feet.

The height of the river above sea level is here 52.49 feet. For a drawing of the section at Saunders' Bluff see Fig. 13. The bank is too steep to be examined in full detail, but we obtained fossil casts partly from ironstone blocks now lying at the base, but fallen from above, and partly from those *in situ* near the top of the fossiliferous strata, that is, at a height of 162 feet above datum line.

Fossils from Saunders' Bluff.

Conus sp.
Turritella murrayana, Tate
Pecten foulcheri, T. Woods
Cardita polynema, Tate
Mytilicardita sp. (also at Skinner's)
Crassatellites dennanti, Tate
Meretrix eburnea, Tate
Meretrix, n. sp. (also at Skinner's)
Bryozoa spp.

XII.—Lindenow.

Just opposite Saunders' Bluff, on the south bank of the river, an interesting outcrop of ironstone occurs. Between the two

sections stretches a wide extent of the fertile Lindenow flats, bounded on the north by the Bluff, and on the south or Lindenow side by a sloping bank, which is covered by a thick alluvial deposit. The ironstone commences at about 60 feet up the bank, and is traceable along a narrow river terrace as far as Moitun Creek on the west, as well as for a long way eastward. At Lindenow the band is fairly massive, and from 15 to 20 feet thick. Owing to small quarrying operations, the face is well exposed, and though we spent only a few hours at the spot, we were able to collect many easily identifiable casts. The section was examined at an early stage of our work, and the results obtained had a large share in convincing us that the ironstone casts on the Mitchell banks from Boggy Creek westward simply represent the eocene forms, which, either in the limestones or in the shell beds at Skinner's and Dreir's, are in most cases still preserved unaltered. We have seen no clearer casts anywhere than at Lindenow, and the palaeontological evidence is thus specially decisive.

Fossils from Lindenow.

Voluta weldii, T. Woods
Siphonalia (?) sp.
Columbella (?) sp.
Murex lophoessus, Tate
Lampusia annectans, Tate
Cassis exigua, T. Woods
Potamides sp.
Turritella murrayana, Tate
Turritella tristira, Tate
Lima bassii, T. Woods
Pecten foulcheri, T. Woods
Pecten sturtianus, Tate (?)
Glycimeris laticostata, Q. and G.
Trigonia semiundulata, Jenkins.
Cardita sp.
Meretrix eburnea, Tate (?)
Chione etheridgei, Pritchard
Chione sp. (also at Skinner's)
Corbula ephamilla, Tate
Cuspidaria subrostrata, Tate
Myadora australis, Johnston
Lunulites rutella, T. Woods
Paradoxechinus novus, Laube
Placotrochus elongatus, Duncan
Placotrochus deltoideus, Duncan

On one occasion when driving along the Lindenow road we observed ironstone rocks cropping out on a grassy bank about half a mile to the south. Leaving the buggy on the road we walked over to the spot and broke up a quantity of the stone. After a prolonged search we found a few fossiliferous blocks, which shewed casts of species identical with some we have recorded from the neighbouring section.

XIII.—Summary and Conclusion.

1. The western boundary of the Gippsland miocene is extended at least as far as Bellevue and Rose Hill. Its exact limits in that direction are not determined, but farther up the river every section examined discloses only a lower tertiary fauna. The highest level at which miocene fossils are recorded in the area is at Knight's, and about 160 feet above sea level. At the mouth of Boggy Creek the river cliff is 194 feet above level, and the eocene strata are continuous up to its summit. Farther west the country still rises, and just beyond Boggy Creek reaches 230 feet, and finally at Moitun Creek 330 feet above datum line. Ironstone blocks, containing eocene fossils, were traced up to an elevation of about 160 feet in both these localities.

2. Since we dissent from Sir F. McCoy's classification of the Moitun and Boggy Creek ironstones as upper miocene or lower pliocene, we cannot accept the theory, apparently founded upon it by Mr. Howitt, viz., that the Bairnsdale limestone is denuded on its north limit and overlain by the Moitun Creek group (1). Professor McCoy determined the age of this group on palaeontological data, but the Report (1) contains no list of the species submitted to him. As a fact, a reliable classification of the Mitchell beds was scarcely possible at the date of the Report (1874). Comparatively few species were known from the Victorian tertiaries generally, while the molluscan bed at the base of the Skinner's section was then practically unworked. The latter of course supplies the key for the interpretation of the Moitun and Boggy Creek casts.

Again, from Lindenow up to Moitun Creek, the Bairnsdale limestone is entirely wanting, and the river banks show instead, on the south, ferruginous sands resting directly upon devonian strata, and on the north, the latter rocks only.

From Bellevue eastward there is, on the contrary, evidence of the erosion of the limestone before the deposition upon it of the so-called upper pliocene (really miocene) beds, and to this extent we are in accord with Mr. Howitt.

The following table shews the classification of the Mitchell tertiaries as given in the Reports (1 and 2), and by ourselves in the present paper.

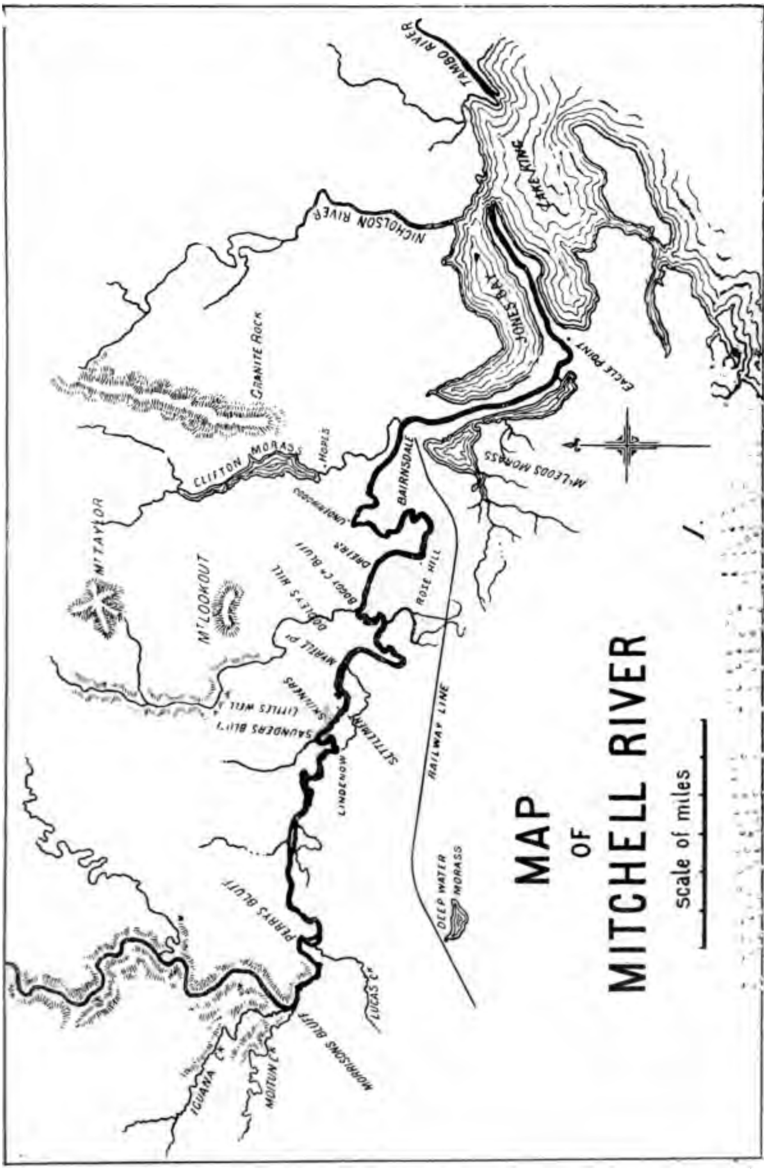
	McCoy.	Howitt.	Dennant and Clark.
Jemmy's Point	Pliocene	Upper Pliocene	Miocene
Bellevue and Rose Hill	——	——	
Moitun Creek and Boggy Creek	Upper Miocene or Lower Pliocene	Lower Pliocene	Eocene
Bairnsdale limestone	Middle Miocene	Middle Miocene	
Skinner's and Dreir's	——		

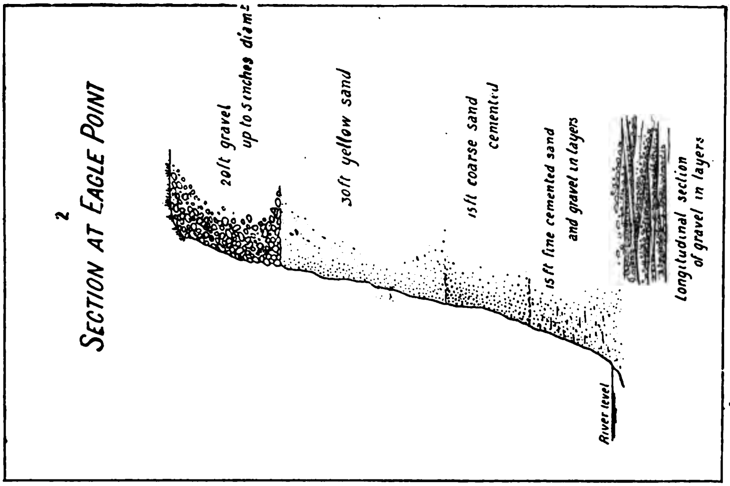
3. The Mitchell River gorge from Moitun Creek downwards has, no doubt, been carved out in post-miocene times, and the drifts and coarse gravels of the terraces, as well as of the country bordering them, have been mainly transported by streams from the northern hills or by the river itself.

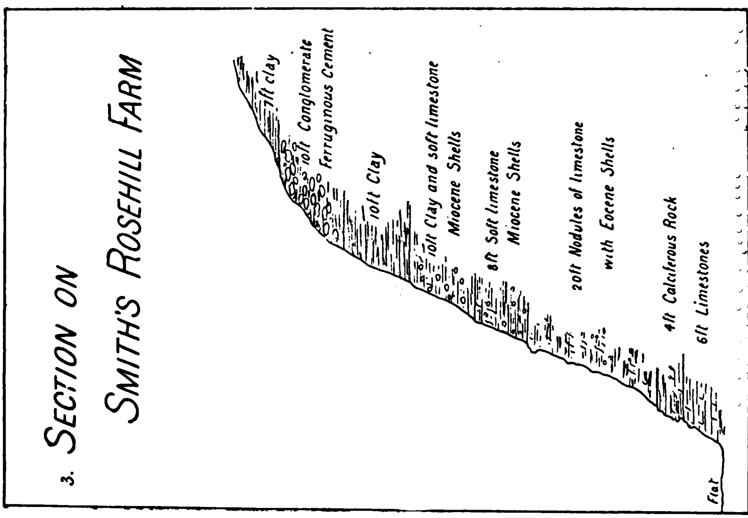
4. On the final elevation of the land at the close of the miocene period, the difference in level between Moitun Creek and the sea does not appear to have been much greater than at present, otherwise the river would have cut a far deeper channel than it has. Say the difference was 150 feet greater, then in such soft material we should expect a wide and deep channel to be cut, which afterwards would be filled up with sediments when the land subsided. There is no evidence of this. At East Bairnsdale, borings have been carried to a depth of 250 feet, or from 180 feet to 200 feet below sea level. Now, at a depth of 150 feet, or not more than 50 feet below sea level, eocene shells were struck. These included Clypeaster gippslandicus, a common form in the Bairnsdale limestone.

Further, the Nicholson and Tambo rivers, which, even now in places, as at Swan Reach, flow between eocene and miocene cliffs, have certainly no deep recent beds beneath them, such as they should have if the country had once been 150 to 200 feet higher and then had subsided to its present level.

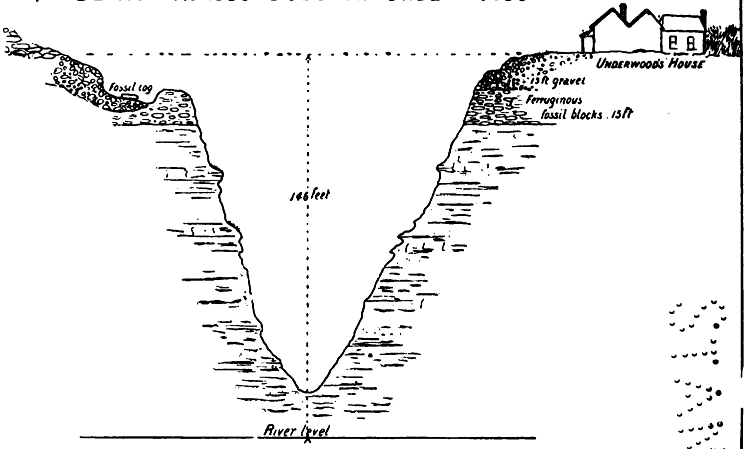
The local evidence is thus opposed to the theory of a former superior elevation of the land, except of course by the amount due to ordinary subaërial denudation.


MAP
OF
MITCHELL RIVER
Scale of miles
TAMBO RIVER
NICHOLSON RIVER
LAKE KING
JONES BAY
EAGLE POINT
McLEODS MORASS
BAIRNSDALE
ROSE HILL
RAILWAY LINE
DEEP WATER MORASS
GRANITE ROCK
CLIFTON MORASS
Mt TAYLOR
Mt LOOKOUT
LINDENOW
PERRYS BLUFF
MORRISONS BLUFF
LUCAS Ck
SAUNDERS BLUFF
LITTLES WELL
SETTLEMENT


2
Section at Eagle Point
20ft gravel up to 5 inches diam.
30ft yellow sand
15ft coarse sand cemented
15ft fine cemented sand and gravel in layers
Longitudinal section of gravel in layers
River level

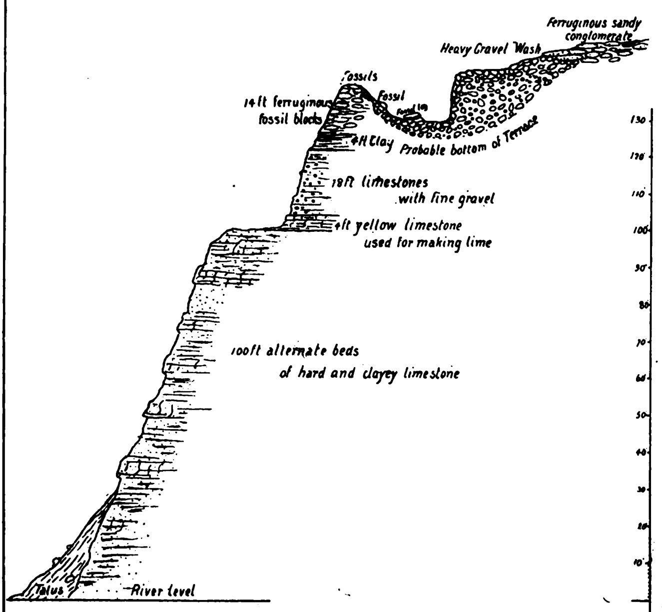

3. Section on Smith's Rosehill Farm
7ft clay
10ft Conglomerate Ferruginous Cement
10ft Clay
10ft Clay and soft limestone Miocene Shells
8ft Soft limestone Miocene Shells
20ft Nodules of limestone with Eocene Shells
4ft Calcerous Rock
6ft Limestones
Flat

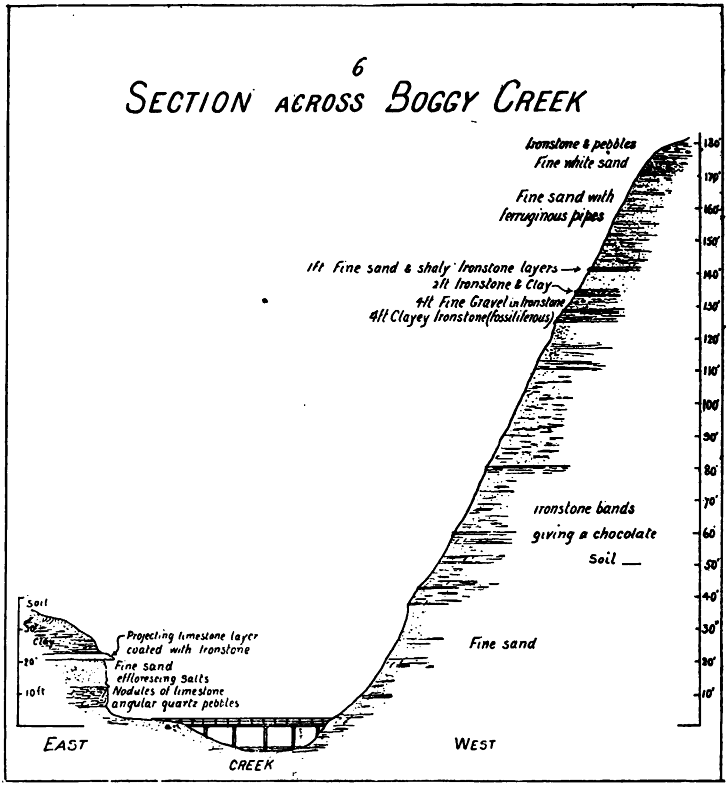
4. SECTION ACROSS GULLY AT UNDERWOODS



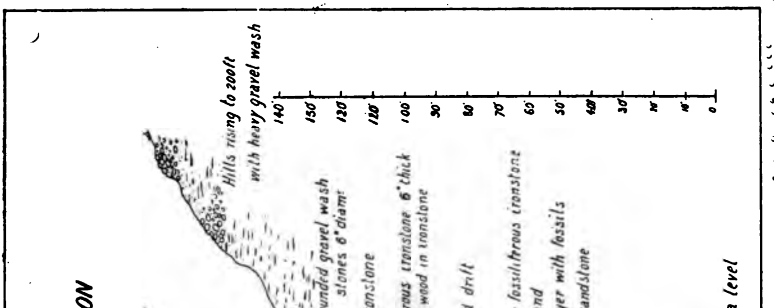
5.

SECTION OF UNDERWOODS CLIFF

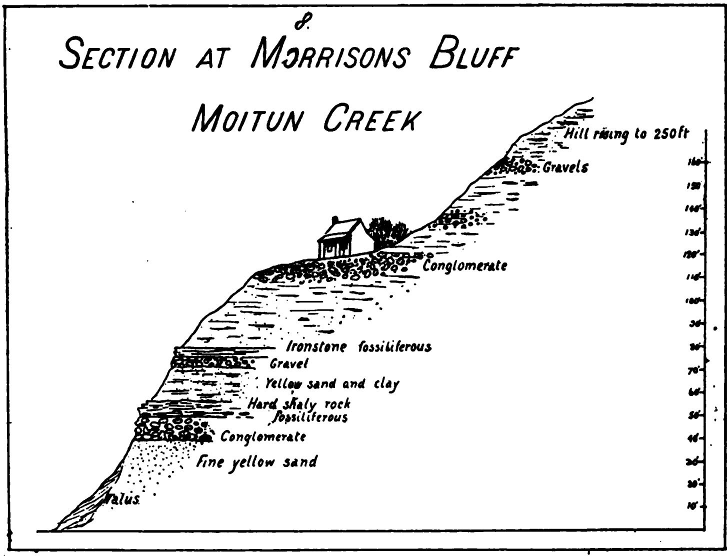


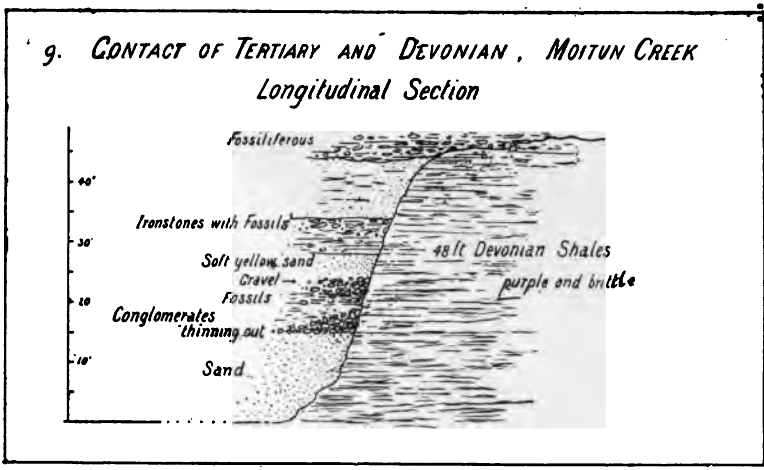


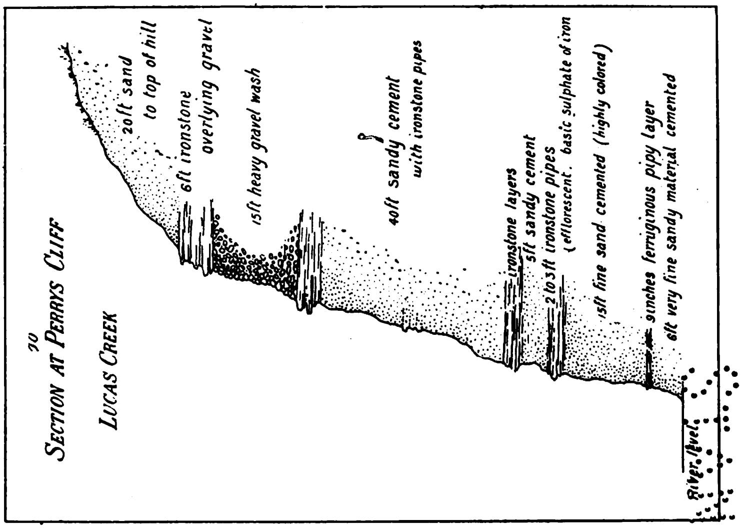
6
SECTION ACROSS BOGGY CREEK

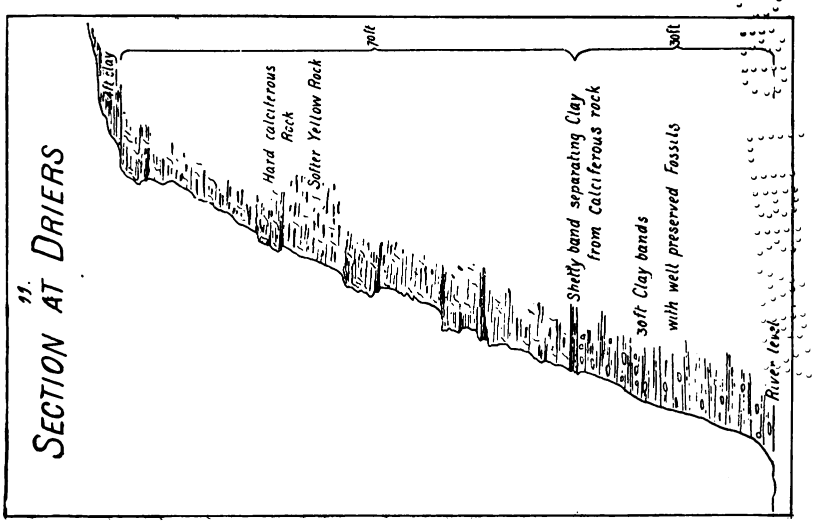


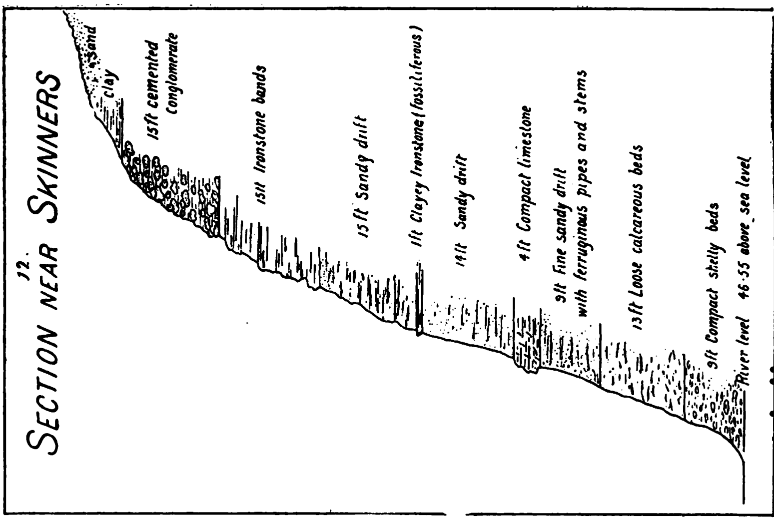
7
SECTION AT JUNCTION OF MITCHELL RIVER AND MOITUN CREEK

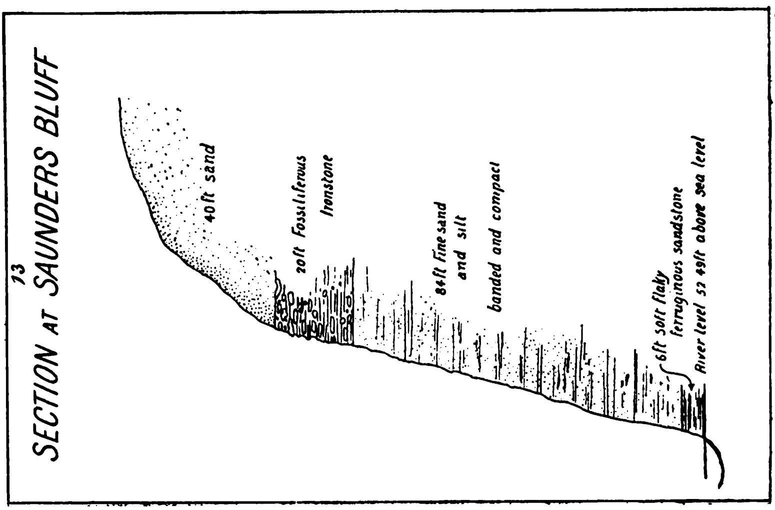

8.
SECTION AT MORRISONS BLUFF
MOITUN CREEK
Hill rising to 250 ft
Gravels
Conglomerate
Ironstone fossiliferous
Gravel
Yellow sand and clay
Hard shaly rock fossiliferous
Conglomerate
Fine yellow sand
Talus


9. CONTACT OF TERTIARY AND DEVONIAN, MOITUN CREEK
Longitudinal Section
40'
30'
20
10'
Fossiliferous
Ironstones with Fossils
Soft yellow sand
Gravel
Fossils
Conglomerates thinning out
Sand
48 ft Devonian Shales purple and brittle


10
SECTION AT PERRYS CLIFF
LUCAS CREEK
20ft sand to top of hill
6ft ironstone overlying gravel
15ft heavy gravel wash
40ft sandy cement with ironstone pipes
ironstone layers
5ft sandy cement
2 to 3ft ironstone pipes
(efflorescent. basic sulphate of iron
15ft fine sand cemented (highly colored)
9inches ferruginous pipy layer
6ft very fine sandy material cemented
River level


11.
SECTION AT DRIERS
5ft clay
70ft
30ft
Hard calciferous Rock
Softer Yellow Rock
Shelly band separating Clay from Calciferous rock
30ft Clay bands with well preserved Fossils
River level


12.
SECTION NEAR SKINNERS
Sand
clay
15ft cemented
Conglomerate
15ft Ironstone bands
15ft Sandy drift
1ft Clayey Ironstone (fossiliferous)
14ft Sandy drift
4ft Compact limestone
9ft Fine sandy drift
with ferruginous pipes and stems
13ft Loose calcareous beds
9ft Compact shelly beds
River level 46·55 above sea level


13
SECTION AT SAUNDERS BLUFF
40ft sand
20ft Fossiliferous
Ironstone
84ft Fine sand
and silt
banded and compact
6ft soft flaky
ferruginous sandstone
River level 52 49ft above sea level

EXPLANATION OF PLATES II. TO VIII.

PLATE II.

Fig. 1.—Map of Mitchell River.

PLATE III.

Fig. 2.—Section at Eagle Point.
„ 3.—Section at Rosehill.

PLATE IV.

Fig. 4.—Section across Gully at Underwood's.
„ 5.—Section of Underwood's Cliff.

PLATE V.

Fig. 6.—Section across Boggy Creek.
„ 7.—Section at Junction of Mitchell River and Moitun Creek.

PLATE VI.

Fig. 8.—Section at Morrison's Bluff.
„ 9.—Contact of Tertiary and Devonian at Moitun Creek.

PLATE VII.

Fig. 10.—Section at Perry's Bluff, Lucas Creek.
„ 11.—Section at Dreir's.

PLATE VIII.

Fig. 12.—Section near Skinner's.
„ 13.—Section at Saunders' Bluff.

Art. III.—*On certain Conglomerates near Sydenham.*

By T. S. HART, M.A., F.G.S.

(With Plate IX.).

[Read 9th April, 1903.].

Among the older rocks exposed along the deep valleys of the Saltwater River and Deep Creek, across the Keilor Plains, there occur certain conglomerates. Apart from the rarity of conglomerates among these rocks, these present certain features of interest.

This portion of the course of the above-mentioned streams is within the area mapped in Quarter-sheet 7 S.E., extending through 2 S.W. into 1 N.W.

The positions of the conglomerates are denoted by the numbers 1 to 7 on the accompanying map. Of these, Nos. 1 and 3 are unnoticed on the Quarter-sheets, Nos. 5 and 6 are indicated by the symbol "C3," but I failed to detect them when going along those parts of the valleys. No. 7 I have only seen on the river bank at the place at which the number is placed, but it is shown on the Quarter-sheet as far north and south as the crosses on the locality map.

Description of the Observed Conglomerates.

The locality 1 is about a mile and a half from Sydenham Railway Station, and close to the fifteenth milepost on the Mount Alexander Road. The right bank of the Saltwater on this bend rises in a steep cliff. At the western end of this cliff are mudstones and sandstones of ordinary character dipping easterly at 70° to vertical or slightly overturned. These are succeeded by mudstones with pebbles scattered through them in various positions, isolated, or in patches, or somewhat in bands. The pebbles are well-worn, but frequently flat-sided, some present glaciated shapes, and, on a few, obscure striations are present. They range in size up to about six inches, and consist of quartz,

quartzite, porcellanite, and quartz-porphyry. These pebbly mudstones have a thickness of about seventeen feet near the water's edge. The matrix is exceptionally somewhat sandy. They are followed by a heavy conglomerate of pebbles of similar character to those in the mudstones, but reaching larger sizes, nearly a foot in diameter, and a few additional rocks were observed, including a greisen.

The pebbles are thickly crowded together, and in various positions, the spaces between large material filled with smaller, and the small quantity of fine material is mainly sandy. The junction with the underlying pebbly mudstones is very uneven; the conglomerate is about 15 feet thick at the water's edge, but contemporaneous erosion has cut away the mudstones higher up the bank and allows the conglomerate to thicken to about 22 feet. In the upper part of the conglomerate there occur two irregular bands of sandstone about 9 inches thick and with few pebbles in them.

The upper surface of the conglomerate is fairly even and is succeeded by a series of pebbly mudstones, similar to those below, for about 40 feet. Then follows an alternation of thin sandstone beds and mudstones, both free from pebbles for about 24 feet. Another band of about 4 feet in thickness and containing pebbles then occurs. The matrix is mainly mudstone but it contains a discontinuous bed of fine sandstone, which, at one place, is folded back on itself, and at another disturbed from its position parallel to the beds. In the upper part of the mudstone and above this sandstone is a band of coarse grit. The next bed following is a sandstone free from pebbles and the pebbles were not observed further at this place.

The series may be tabulated thus :—

Uppermost, eastern end :

Mudstone, with pebbles, and grit band and fine sandstone bed disturbed -	4 feet
Alternating mudstones and sandstones, without pebbles - - - -	24 „
Pebbly mudstones - - - - -	40 „
Heavy conglomerate - - - -	15 to 22 „
Pebbly mudstones - - - - -	17 to 10 „
Total	100 feet.

These conglomerates are clearly interbedded with the ordinary Palaeozoic rocks. They are jointed, so much so, that it is difficult to extract pebbles whole. Joint planes can be traced through the pebbly mudstones and conglomerate, and on one of these a thin vein of quartz has since formed. This quartz vein is most easily seen in the pebbles and can be clearly seen crossing older quartz pebbles.

Crumpling in the lamination of the finer beds was noticed, but they are not often visibly laminated. At places a pebble is indented by a neighbouring pebble.

Locality No. 2 is some little distance down the river just before the basalt forms the river bed. The conglomerates are here exposed in a low bank and on the shelving surface of rock near the water and liable to be covered. It is marked on the Quarter-sheet. A conglomerate bed, about 15 feet in thickness, contains pebbles similar in shape and material to the others described, the pebbles reaching a size of about 6 inches. Below it is a patch of pebbles at a distance of about 2 feet. About 30 feet further east (higher in the beds) a band occurs of pebbly beds 2 feet 9 inches, conglomerate 2 feet 3 inches, pebbly beds 2 feet, these layers merging into one another. The matrix of the pebbly beds is here more sandy. The pebbles reach to about 9 inches diameter.

Locality No. 3, on the right bank of the Deep Creek a little above the junction. Here are scattered pebbles, some flat faced, in a compact mudstone matrix. The whole thickness seen was about 8 feet. In it is a band of 7 inches of sandstone without pebbles. Its strike, if continued, would take the beds west of the locality 5.

Locality No. 4, close to the granite in Deep Creek. All the rocks are much indurated to a hardness comparable with the pebbles and on old surfaces pebbles seldom stand out and are not easily noticed. The hardness and splintery character of the altered rock makes examination difficult. Some of the pebbles are flat sided; the largest pebble noticed was of quartz about 8 inches diameter. The bed observed had a thickness of about 10 feet, it is close to a large granite dyke. Quartzite with pebbles and a rock, which might represent the pebbly mudstones, are also present here, as blocks may be seen in the creek. The general character, so far as was seen, was similar to what might be

expected from material like that at locality No. 1, altered at the granite contact. The general dip here is easterly at about 60°.

At localities 5 and 6 I did not see the conglomerate.

At locality 7, conglomerate is seen on the right bank of the Saltwater north of Keilor township. The pebbles, to about 10 inches in size, are mainly quartz and quartzite, similar to those at No. 1, in a matrix mostly sandy, but I did not notice any pebbly mudstones. The northerly extension marked on the quarter sheet is mostly under an alluvial flat. About the southern end also little rock is exposed. At the point where they were observed the dip is about 50° westerly and the strike east of north. The thickness exposed is about 10 feet. The beds immediately below are mudstones without pebbles and above sandstone without pebbles and again a thin conglomerate bed.

Glacial Origin of the Pebbly Beds.

The manner of occurence and distribution of the pebbles through the mudstones suggests at once a glacial transport. The pebbles are of various sizes and in various positions and are embedded in and scattered through a matrix which, even when sandy, would have been completely removed by any current competent to move the pebbles. Only exceptionally are the pebbles so crowded that fine material could have lodged among them and this crowding is only in patches. The general aspect, expect as to inclination, is very similar to parts of the glacial deposits of Bacchus Marsh and elsewhere. They agree also very closely with the description recently given by Mr. Howchin[1] of certain supposed Cambrian glacial beds near Adelaide, only that here the pebbles do not reach anything near the same dimensions.

Glaciated pebbles and some striated occur, associated indeed with many rounded ones, and an examination of the matrix in the lower pebbly mudstones at locality 1 shows that it is clear and sharp, rather abraded than weathered material. Some of the pebbles show crystals of pyrite ground down but not decomposed. While no other explanation except glacial transport seems practicable for the general characters of the deposit, the relations to the beds above and below preclude any idea of accumulation

1 Trans. Royal Society S.A., vol. xxv., pt. i., 1901.

on land. The mudstones containing the pebbles and sandstones between them at locality 1, and as far as noticed elsewhere, are essentially part of a continuous series extending both above and below them, under generally similar conditions, undoubtedly marine. We are therefore limited to transport by floating ice, not by land ice. With this agrees the disturbance of the fine sandstone near the top of the series at locality No. 1, which would be ascribable to stranding of the floating ice. The disturbance is quite different from that which I have before ascribed to differences of rigidity under folding in the Ordovician rocks.[1]

While icebergs from extensive ice sheets and glaciers often carry little foreign material compared with their bulk, the case is essentially different with shore ice and river ice. Nor are the glaciated stones sufficiently numerous or distinct to regard the ice as the only agent operating.

The following description of the Yukon by Mr. I. C. Russell seems to fulfil the conditions of this case.

The Yukon "freezes deeply during the winter and the ice near its borders, especially when it is broad and shallow, rests on the bottom and has large quantities of stone and boulders attached to it. All except the largest of the tributory streams freeze to the bottom and also furnish vast quantities of pebbles for ice transportation. When the rivers break up in the spring, the ice with its loads of stone is floated down stream, and melting, as it goes, distributes pebbles and boulders over the bottom of the river and in places where at other times fine sediment is deposited. In this way it is conceivable that a clay filled with boulders might be formed which would simulate true boulder clay in many ways. Certain boulder clays along the Yukon and the Lewes are described elsewhere in this paper, which, as there stated, may have been formed in the manner here suggested."[2]

Now, it will be evident that the formation of such a deposit resembling boulder clay will not be limited to the course of the river but may occur as far as the ice can reach in floating out to sea and that shore ice may behave in just the same manner. The

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1 Proc. Royal Society Vic., vol. xiv., pt. ii n.s.

2 Bull. Geol. Soc. Amer., vol. i., 1890.

materials carried will be firstly river gravels or coast shingle as the case may be, but among those from the river glaciated stones may occur in two ways. It is noted on the Yukon, by the same writer, that stones embedded in the clay on the banks become ground on one side by the stranding of river ice, especially in spring floods while ice barriers still exist in the river. The material also in the river may itself be largely derived form glaciers, as the nature of the mudstone matrix would suggest in this case.

The pebbles will naturally be more numerous in mudstones because first the mudstone being more slowly formed than the sandstone as a rule, more ice is likely to float across it while a given thickness is deposited, and, secondly, because the current being more gentle more of the ice is melted as it passes over it at a slow speed. No indentation need be seen on the beds even if they are laminated, for the stones may sink gently with ice still attached.

A minor arrangement of the pebbles as continuous bands may readily occur by the drift ice being more abundant at certain times or a tendency of the ice to accumulate at certain places.

The character of the pebbly mudstones and sandstones is just what might be expected off a coast along which the climate was such that considerable rivers could freeze to the bottom in winter and much shore ice could be formed. Such a condition may be associated with neighbouring general glaciation as at present in Alaska, where glaciers occur south of the Yukon. The moderate size of the largest boulders also favours this view.

The formation of the heavy conglomerate under such conditions may be due to ordinary current transport, and the erosion of the underlying mudstones favours this view. The stranding of ice would however assist, when by gradual melting at one place, a heterogeneous mass of gravel of all sorts and sizes would readily accumulate, and the stranding and the rocking of the stranded masses might also have caused the erosion.

The severe climatic conditions might also contribute to the complete break in the fossil fauna which seems to occur about this horizon.

These evidences of glacial action occur at the localities Nos. 1, 2, 3 and 4, but I did not notice them at No. 7 (Keilor).

Source of the Material.

The materials of the pebbles require for their supply a land surface of sedimentary rocks already invaded and altered by igneous rocks and with volcanic rocks also exposed. The altered sedimentary rocks are represented by the quartzite, porcellanite and lydianite; the igneous by the quartz porphyry, greisen, a peculiar fine graphic granite, and a vescular fragment. Vein quartz also occurs.

The land area of Heathcotian rocks, as recently described by Dr. Gregory[1] may have provided these materials. The position of the beds is in the gap existing in Upper Ordovician times in the ridge southward from Lancefield ranges.

Age of the Conglomerates.

In a former paper referring to these conglomerates, I stated that their Ordovician age was uncertain.

The Quarter-sheet appears to show all the palaeozoic rock in 7. S.E. as "Lower Silurian" a number of fossils being recorded at the north-west corner of the sheet. As the whole of the bedrock exposed along the Saltwater in 2. S.W. is mapped as "Upper Silurian" the question of the actual contact appears to be avoided. There is a fossil locality Ba60 marked on the Deep Creek (close to locality 5) of which I have found no mention in published reports, but it would support, no doubt, the extension of the "Lower Silurian" colouring to the Deep Creek, which is near the east side of the sheet. On a copy of 7 S.E., at the Melbourne Public Library, I found that the Lower Silurian colouring stops a short distance before the edge of the Quarter-sheet (at the line J on the locality map), a small space being left uncoloured. In all other copies I remember to have seen the "Lower Silurian" colouring extends to the edge of the sheet.

On visiting the locality, this part of the river channel looked at first very unpromising for rock exposures, alluvial material being abundant; but the river being low, a small outcrop of rock was found exposed on the right bank close to the water within the area uncoloured on the Public Library map. A rough observation of strike and dip gave strike about N. 30° W. dip

1 Proc. Royal Society Vic., vol. xv., pt. ii., n.s.

easterly at 47°. About 15 chains to the N.W. the beds exposed on a steep bank appear to strike N. 5° W. and are nearly vertical. Directly over this, in a track cut up the hillside, the apparent dip is only 35° easterly, but this may be due to slipping on the steep hillside. Higher up stream a good exposure gave a strike N. 10°, W. and dip about 70° easterly, not westerly, as shown here on the Quarter-sheet, and, from here up, high dips are the rule. Down stream in sheet 2 S.W. there is at first an easterly dip about 45° becoming much less further on, and continuing moderate as far as Keilor. The position then at which the colouring ends on the Public Library copy is the boundary between the general high dips on the north-west and the moderate or low dips on the south-east. With the river at a higher level this boundary might easily have been placed further east at the edge of the quarter sheet.

About a mile to the north west (H on map) a strike N. 18° W. dip about 30° easterly occurs in a low cliff, but near the water's edge the dip is 70° easterly and the strike different, considerably nearer to north. Between the places of these observations there is a fault to which the beds turn from both sides, but the observations were taken clear of all noticeable turning.

The age of the conglomerates in 7. S.E. may then be regarded as Upper Ordovician probably mostly in slightly lower beds than the fossils of Ba60. Exact comparison of positions of different beds would be affected by faults which are probably common.

The conglomerate at Keilor is close to localities from which "Upper Silurian" fossils are recorded. Going north from locality 7 the strata exposed form an anticline with a strong northerly pitch, dips and strike being apparently very variable: at one place strike N. 82° E., dip 35° northerly. The beds exposed to the north are therefore newer, and the Keilor conglomerate is probably near the lowest beds exposed in the Silurian area within the limits of the area under consideration.

Two explanations of the relations of the two series might be offered.

The moderate dips and irregular strikes of the upper beds may be due to their occupying a crumpled syncline, of which the older beds to the west form one flank, with a steeper, more regular, dip and strike. This receives some support from the fact that some

miles higher up the Deep Creek high dips are prevalent in areas mapped as "Upper Silurian."

The alternative is that we have here two distinct series, one of which dips less steeply than the other and rests unconformably on it (at J an unconformity could be avoided by a faulted junction such as occurs at H). That they are two independent series is more likely, for the relations of the dip and strike of the two series at J and H are very similar and agree well with what would occur on a parallel anticline to that of Keilor, also with a northerly pitch, whereas in irregular minor crumpling in a syncline such correspondence seems unlikely. I have already mentioned that I did not notice glacial evidences at Keilor. The material seemed to have been derived from the same land surface as the other conglomerates, not necessarily under the same conditions.

I am not aware of any previous notice of glacial conditions in Ordovician time in Australia. An occurrence of probably glacial origin is described by Mr. W. Howchin, F.G.S., in Kangaroo Island,[5] which is older than the prevailing glacial series there, but, though its age is uncertain, it does not seem to be referable to quite as early an age as this.

The series more recently described by him near Adelaide, and already referred to, is regarded as Cambrian on the general weight of the evidence.

There are a number of Victorian localities at which the existence of glacial rocks has been noticed without much evidence as to the relations to other beds. No doubt the majority of these belong to the Bacchus Marsh series, but the existence of others of this series is also possible.

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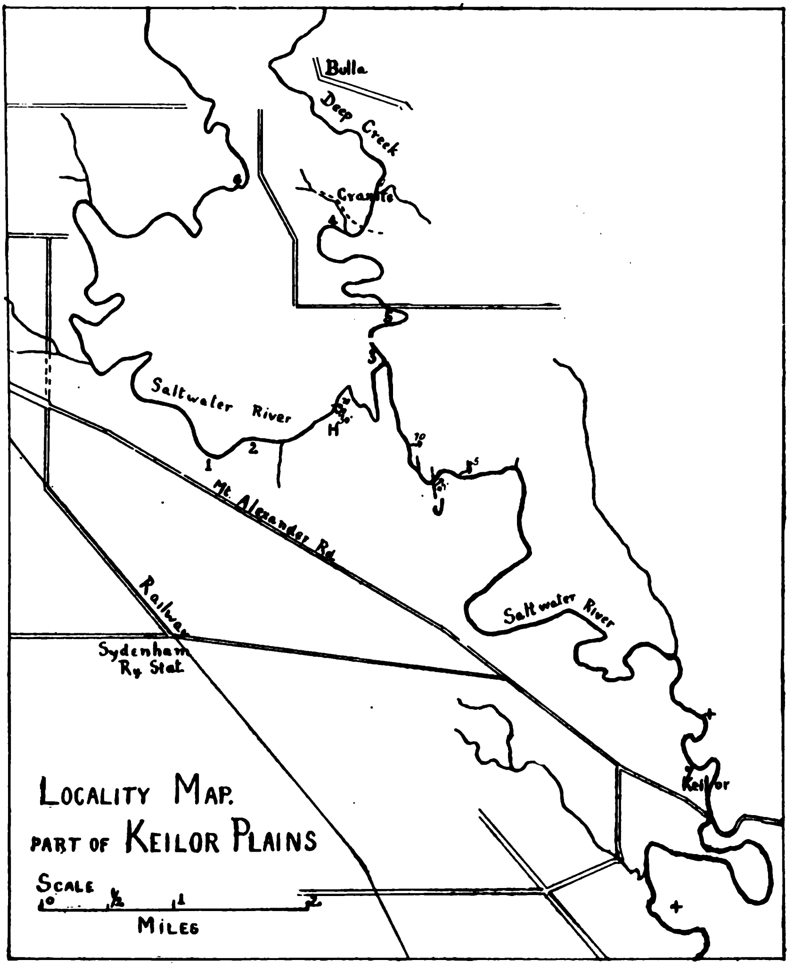
[5] Tran. Roy. Soc. S.A., vol. xxiii., pt. ii., 1899.


Bulla
Deep Creek
Granite
Saltwater River
H
J
Mt. Alexander Rd.
Railway
Sydenham
Ry. Stat.
Saltwater River
Keilor
LOCALITY MAP.
PART OF KEILOR PLAINS
SCALE
0
½
1
2
MILES

Art. IV.—*On the Occurrence of Striated Boulders in the Permo-Carboniferous Rocks near the mouth of the Shoalhaven River, New South Wales.*

By E. O. THIELE.

[Read 9th April, 1903.].

Since 1859, when Dr. A. R. C. Selwyn[1] recorded indications of ice action in the Inman valley, in South Australia, fresh evidence has been forthcoming from various sources, indicating wide-spread glacial conditions in the Permo-Carboniferous rocks of Australia. In Eastern Australia boulder beds exist as far north as the Bowen River Coalfield, Queensland,[2] and are well-known at several places in New South Wales,[3] notably at Branxton and Lochinvar; while in Victoria, the Bacchus Marsh[4] deposits are the most extensive and best-known among the somewhat numerous occurrences of smaller area in various parts of the State.

In Tasmania again, the glacial beds are widely distributed, being well-developed at Maria Island,[5] Little Peppermint Bay,[6] and at Wynyard.[7]

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1 "Geological Notes of a Journey in South Australia, from Cape Jarvis to Mount Serle." A. R. C. Selwyn, Parliamentary Paper, No. 20, Adelaide, 1859, p. 4.

2 "Report on the Bowen River Coalfield." R. L. Jack, F.G.S., p. 7, par. 39, Brisbane, 1879.

3 "Evidence of Glacial Action in the Carboniferous and Hawkesbury Series, in New South Wales." Professor T. W. E. David, B.A., F.G.S., Q.J.G.S., vol. xliii., pp. 190-196. "Glacial Action in Australia, in Permo-Carboniferous Time." Professor T. W. E. David, B.A., F.G.S., Q.J.G.S., vol. lii., pp. 289-301. "Discovery of Glaciated Boulders at the base of the Permo-Carboniferous System, Lochinvar, New South Wales." Prof. T. W. E. David, B.A., F.G.S., Jour. Roy. Soc. New South Wales, vol. xxiii., p. 154.

4 Note.—The papers on the Bacchus Marsh Deposits are extremely numerous. *c.f.* Note on the Bibliography of the Bacchus Marsh Deposits, by T. S. Hall, M.A., in the Victorian Naturalist, Melbourne, 1894, pp. 125-128; and a note also by A. E. Kitson, F.G.S., in his paper on the Glacial Beds at Wynyard, Tasmania. Proc. Roy. Soc. Vic., vol. xv. (n.s.), Pt. I., 1902, p. 30.

5 Note on Fossils from Maria Island, with evidence of glacial action consisting of huge ice-born erratics embedded in rocks of Permo-Carboniferous age. R. M. Johnston, F.L.S., Proc. Roy. Soc. Tas., p. 20, 1884. Notes on the Geology of Bruni Island. R. M. Johnston, F.L.S., Proc. Roy. Soc. Tas., pp. 18-26, 1886.

6 The Glacial Beds of Little Peppermint Bay, Tasmania. Prof. E. G. Hogg, M.A. Report of Secretary of Mines for Tasmania, 1900-1, and Proc. Roy. Soc. Tasmania, 1902.

7 On the Occurrence of Glacial Beds at Wynyard, near Table Cape, Tasmania. A. E. Kitson, F.G.S., Proc. Roy. Soc. Victoria, vol. xv., (n.s.), pt. i., 1902.

The rocks referred to in this paper occur along the New South Wales coast on the south side of the present outlet of the Shoalhaven River at Crookhaven. They form a small headland on which the Crookhaven lighthouse stands and also stretch a short distance southwards, as a somewhat broken line of low cliffs. Further south, the coast is low and stretches as a sandy beach for some miles, beyond which, again, the higher cliffs in the neighbourhood of Jervis Bay run out to sea. To the north of the Shoalhaven entrance, another stretch of sandy beach extends in the direction of Gerringong, where the well known fossiliferous tuff beds of Black Head form an important feature of the coast line.

The area under consideration is mapped as Permo-Carboniferous, and the late C. S. Wilkinson[1] in referring to this part of the coast line says "At Wollongong, Kiama, and on both sides of Jervis Bay, the marine beds of the Lower Coal Measures occur." The rocks consist of more or less horizontally bedded dark coloured argillaceous sandstones, but just to the south of the Crookhaven headland, there is a slight arch with the axis running out to sea, and a little to the north of this line, the marine platform is cut into by a channel, about half a chain wide, running more or less at right angles to the coast line and evidently due to the more rapid weathering of a dyke.

A small remnant of what appears to be portion of the igneous rock *in situ*, protrudes through the sand in the centre of the channel towards the shore end; it consists of a fine grained greenish grey rock.

The shore shingle consists of a great variety of rocks and an examination of the marine platform shows it to contain rocks of the same nature, embedded so firmly, that it was extremely difficult to extract them without injuring or breaking them. These boulders are of all sizes, from small pebbles up to blocks a foot or more in length; many are smoothed, but sometimes only on one or two sides, while in shape they are mostly irregular, often somewhat triangular and elongate. Various kinds of igneous and metamorphic rocks, such as porphyritic and granitic rocks, schists and quartzites were observed, but time did not permit of extensive collecting. A few likely boulders however were extracted and fortunately several showed distinct polishing, with

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[1] Notes on the Geology of New South Wales. C. S. Wilkinson, F.G.S., F.L.S., Department of Mines, Sydney, 1882, p. 51.

grooving and striation on the underside; the others were so coated with oxide of iron, that any fine markings which may have been present were completely masked.

One of the best specimens consisted of a block of quartzite, which before removal measured over 12 inches along its greatest length; the top side was rough and irregular and it was rather badly jointed, so that it broke into several pieces on being chiselled out. The under side was polished, grooved and finely striated, while several of the sides were faced and imperfectly smoothed.

Further south again at Jervis Bay, in the neighbourhood of the small township of Huskisson similar beds occur, but the boulders were not so numerous and none of the few examined showed striation. Some large granitic blocks however were observed resting on the marine platform, and though these were not embedded they had evidently weathered out of the beds, for similar rocks of smaller size were seen *in situ.* The largest of these loose boulders measured, roughly, about 6 feet by 2 feet by 1½ feet. The rocks here are fossiliferous, several spirifers, and a Platychisma being collected.

In 1861, somewhat similar features in rocks at Wollongong were described by the late Dr. T. Oldham[1], and the beds were compared with conglomerates in the Indian Talchir series, but no striated boulders were recorded, nor was ice-action suggested at the time to explain the origin of the formation. Later, however, the glacial origin of the Talchir beds was more fully worked out, and in 1885, Mr. R. D. Oldham,[2] A.R.S.M., of the Geological Survey of India, examined the New South Wales coal-bearing beds; he established the glacial origin of the conglomerates at Branxton, Wollongong and elsewhere, and confirmed the correctness of the previous correlation of the Australian Permo-Carboniferous beds with the Indian coal-bearing series and their associated boulder beds.

It appears then, that the presence of striated boulders in the beds at Crookhaven affords further evidence of the prevalence, in Permo-Carboniferous seas even in low latitudes, of floating ice, which, as it melted, dropped its load of stones on the muddy sea floor.

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1 Mem. Geol. Survey of India, vol. iii., p. 209.

2 Record Geol. Survey of India, vol. xix., pt. i., p. 44.

ART. V.—*New or Little-known Victorian Fossils in the National Museum.*

PART II.—SOME SILURIAN MOLLUSCOIDEA.

BY FREDERICK CHAPMAN, A.L.S., &c.,

National Museum.

(With Plates X., XI., and XII.).

[Read 14th May, 1903].

Certain of the species herein described as new forms undoubtedly show a more or less close relationship to well-known European and North American types, both as to their general features and superficial ornament. The Victorian examples are here regarded as distinct only when they exhibit constant and well-marked, though often minute, characters of their own. At the same time it is our aim to point out their relationships, in order that the homotaxial affinities between the southern and northern forms may be kept in view. It should be remembered, however, that the value of a correlation between limited horizons in widely separated areas is liable to be unduly overestimated, since we have conclusive proof afforded us, by the detailed study of certain groups of Australasian fossils, as the Graptolites and the Glossopteris flora, that formations which appear distinct in the southern area include fossils which in the northern hemisphere, and especially in Europe, would be regarded as representing a mixed fauna or flora. In other words certain types of fossils occurring in older or younger formations in Europe or India, may, in Australia be associated together in the same stratigraphical series.[1]

The species now under description fall into one or other of the two series of the Silurian, as defined by Professor J. W. Gregory,[2]

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1 For a further discussion on this subject see T. S. Hall's Presidential Address, Section C, Austral. Assoc. Adv. Sci., Hobart Meeting, 1901, p. 165.

2 J. W. Gregory: "The Heathcotian," Proc. Roy. Soc. Victoria, n.s., vol. xv., pt. ii., pp. 170-3.

MELBOURNIAN.

Lingula spryi, sp. nov.
„ latior, sp. nov.
Siphonotreta australis, sp. nov.
Orbiculoidea selwyni, sp. nov.
Craniella lata, sp. nov.
Chonetes melbournensis, sp. nov.

YERINGIAN.

Fenestella margaritifera, sp. nov.
„ australis, sp. nov.
Stropheodonta (Brachyprion) lilydalensis, sp. nov.
„ (Leptostrophia) alata, sp. nov.
Strophonella euglyphoides, sp. nov.
Plectambonites transversalis, Wahlenberg, sp.
„ cresswelli, sp. nov.
Chonetes robusta, sp. nov.
cresswelli, sp. nov.
Uncinulus stricklandi, Sow. sp.

Class POLYZOA.

Genus *Fenestella*, Lonsdale.

Fenestella margaritifera, sp. nov. (Pl. X., Figs. 1-3).

Specific characters.—Zoarium funnel-shaped, rather short, the height being nearly equal to the breadth at the rim. Inner (poriferous) surface having straight, divergent branches; bifurcation occurring on a length of about ten fenestrules. Zooecia in two series on either side of a prominent, beaded keel, and arranged in a curve close to the lateral borders of the fenestrules. The zooecia are prominent, papillose, with a central rounded orifice, and are usually disposed in fives on the sides of the fenestrules. The latter are elliptical, or more rarely sub-quadrate. Dissepiments at very regular intervals, and as a rule laterally coincident with one another, but occasionally alternate. External surface of the zoarium having straight branches, with rounded surfaces, and usually plain, but tending to become granulate.

MEASUREMENTS.

Average height of zoarium, 20 mm.
Average width of zoarium, 25 mm.
Diameter of a zooecium with vestibule, ·06 mm.
Number of fenestrules in a length of 10 mm. = 11 to 13.
Number of fenestrules in a width of 10 mm. = 14 to 17.

Affinities.—This species is clearly allied to F. fossula, described by Lonsdale from the Carbo-permian of New South Wales and Tasmania.[1] The latter differs however, in the smaller number of the zooecia, in their more or less parallel arrangement, in the apparent absence of a prominent vestibule (Lonsdale's fig. 1. being that of a *cast* from the celluliferous face), and in the sub-rectangular or long elliptical form of the fenestrules. The zoarium of F. fossula attains to a much larger size than F. margaritifera.

In its prominent zooecia, and the tuberculated carinae the present species belongs to the type of F. retiformis, Schlotheim.

Occurrence.—F. margaritifera appears to be of frequent occurrence (judging by the relative proportion of associated fossils, in the small collection in the National Museum from the localities cited) at the junction of the Worri-Yallock and Yarra, Geol. Surv. Victoria, B 23 [587-8]; and at Yering, Upper Yarra, Geol. Surv. Victoria [592-5].

The matrix in which these fossils occur is an ochreous and somewhat indurated clay. The fossils are represented chiefly as casts; in some instances, however, the original structure of the fossil is preserved.

Horizon.—Highest beds of the Silurian (Yeringian).

Note.—In Smyth's Progress Report, Geol. Surv. Victoria, 1874, p. 34, Sir F. McCoy recorded two new species of Fenestella from the Upper Yarra District. Up to the present, the above species is the only new form which the writer has been able to discover in the Survey collections from that locality.

Fenestella australis, sp. nov. (Pl. X., Fig. 11).

Specific characters.—Zoarium funnel-shaped, somewhat elongate; surface undulate. Inner surface with circular, open zooecia

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1 In Strzelecki's Phys. Descr. New South Wales, 1845, p. 269, pl. ix., figs. 1, 1a.

arranged in two series as in F. subantiqua, d'Orbigny and F. antiqua, Goldfuss sp.; from four to six opposite each fenestrule. Branches slender and somewhat sinuous; sharply keeled; bifurcating in an irregular manner, the angle often wide, the fission taking place usually at every fourth fenestrule. External surface non-poriferous; branches with a rounded and fairly smooth surface.

MEASUREMENTS.

Height of zoarium, about 13 mm.
Width of zoarium, about 10 mm.
Diameter of zooecium, .08 mm.
Average number of fenestrules in a length of 10 mm. = 8.
Average number of fenestrules in a width of 10 mm. = 12.

Affinities.—In F. morrisii from the Upper Palaeozoic of Burragood, New South Wales,[1] we have a similar kind of branching, but the zooecial arrangement is not so regularly serial as in our species, and the branches have a feebly developed carina. The nearest allied form to ours seems to be F. multiporata, de Koninck (non McCoy),[2] especially with reference to its strong carina and regularly arranged pores. The fenestrules are, however, elongate rectangular in the latter species, whilst in F. australis they are sub-rectangular to sub-elliptical, and further, the dissepiments in the latter form are wider.

F. adraste, Hall and Simpson,[3] from the Lower Helderberg Group, near Clarksville, New York, bears close comparison with our form; the fenestrules, however, are smaller and more ovate, whilst the zooecia are not so numerous, and the carina flattened externally.

Occurrence.—In the dark bluish limestone of Deep Creek, seven miles to the south-east of Walhalla, Gippsland. The material was collected and presented by the Rev. A. W. Cresswell, M.A. [589-91]. Also figured specimen [1205A].

Horizon.—Silurian (Yeringian).

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1 McCoy, 1884, Syn. Carb. Foss. Ireland, p. 203, pl. xxviii., fig. 13. de Koninck, 1877, Pal. Foss. New South Wales (Transl. by David and Dun, 1898), p. 135, pl. vii., fig. 8.

2 *Op. cit.*, 1898, p. 134, pl. viii., fig. 4.

3 Natural History of New York, vol. vi., 1887, p. 48, pl. xx., figs. 19-22.

Class BRACHIOPODA.

Genus *Lingula*, Bruguière.

Lingula spryi, sp. nov. (Pl. X., Figs. 9, 9*a*).

Specific characters.—Valves subovate, sides evenly rounded, with an acuminate border below the beak; the latter only very slightly ridged; broadly rounded anteriorly. Surface depressed convex, highest at the posterior third of the length, thence gradually sloping and becoming flattened towards the anterior border. Surface smooth, with numerous, but rather faint growth-lines. A faint frilling on the anterior margin, and on one or two of the curved areas between the growth-lines in the median region of the valve may be seen when the light is directed across the shell.

MEASUREMENTS.

Length of largest specimen	- -	7.6 mm.
Width of largest specimen	- -	6 „
Thickness of united valves, about	-	1.2 „

Affinities.—The broadly spatulate form of the valve in this species recalls some of the broader varieties of L. attenuatus, Sowerby,[1] but the latter form is typically narrower and more acuminate posteriorly. Another form with which ours may be compared, especially with regard to the surface convexity, is L. symondsi, Davidson.[2] The noteworthy differences which separate L. spryi from these species are the evenly rounded and almost circular anterior margin, and the radial frilling of the surface between the growth-lines. Lastly the L. perlata, J. Hall,[3] from the Helderberg group of Albany, U.S.A., resembles our form in the general outline of the valves, excepting that the above-named species has not such an evenly rounded anterior margin, whilst the concentric lines of growth are more deeply sculptured.

Occurrence.—Found in the pale purplish argillaceous rock in and around Melbourne, namely, in the Swanston Street sewerage

1 In Murchison's Silurian System, 1839, pl. xxii., fig. 13; also Davidson, Brit. Sil. Brachiopoda, 1866 (Mon. Pal. Soc.), p. 44, pl. iii., figs. 18-27 (*c.f.*, fig. 19).

2 L. symondsi, Davidson (Salter MS.), Brit. Sil. Brach., p. 45, pl. iii., figs. 7-17.

3 Palaeontology of New York, 1859, vol. iii., p. 156, pl. ix., figs. 3-5.

excavations near Collins Street [598-9], and also at South Yarra (Yarra Improvements)—[596]. The similar colouration and appearance of the rock from both localities point to the probability of their being on the same geological horizon for although the Silurian rocks vary considerably in their lithological appearance in a vertical direction in these localities, they show persistent characters over the same zonal area. Collected by Mr. F. Spry, in whose honour the species is named.

Horizon.—Silurian (Melbournian).

Lingula latior, sp. nov. (Pl. X., Figs. 10, 10*a*).

Specific characters.—Valve subovate, sides sloping outwards towards the anterior border, which is broad and well-rounded; beak somewhat blunt but prominent. Surface smooth, strongly convex, and marked by a few faint growth-lines; a few radial creases start from the umbo and traverse the greater part of the shell-surface. The impressions of the pedicle and protractor muscles are faintly seen on the shell.

Measurements.

Length of valve - - -	4	mm.
Width of valve - - -	3.6	,,
Thickness about - - -	1.3	,,

Affinities.—The form of this shell is of the L. squamiformis type[1], but it is not so straight along the posterior border. It most resembles L. lata of Sowerby[2], from the Lower Ludlow rocks of England and Scotland, but differs from it in many points, and especially in the stronger convexity of the surface.

Occurrence.—In bluish argillaceous rock, South Yarra (Yarra Improvements), Melbourne. Collected by Mr. F. Spry [59].

Horizon.—Silurian (Melbournian).

Genus *Siphonotreta*, de Verneuil.

Siphonotreta australis, sp. nov. (Pl. X., Figs. 7, 8, 13; Pl. XI., Fig. 1).

Specific characters.—Pedicle valve broadly ovate, surface highest near pedicle opening, sloping steeply to the sides and

1 Phillips: Geol. Yorkshire, 1836, vol. ii. p. 221, pl. xi., fig. 14.

2 In Murchison's Silurian System, 1839, p. 618, pl. viii., fig. 11.

gently towards the anterior border. The edges of the lateral shoulders nearly straight and meeting the boldly curving anterior margin at less than halfway from the umbo. Shell thin and wrinkled externally, boldly relieved by deep curved lines of growth, about 10 or 12, from their salient edges proceed numerous spines, of which only vestiges remain. There are also indications of surface pittings between the bases of the spines. Pedicle opening small, circular, and with a depression indicating the position of the underlying pedicle tube which proceeds from it anteriorly (Fig. 8). Dorsal valve smaller, depressed-convex, and sub-circular in form. The internal cast of the pedicle valve shows the position of the foramen at the summit of the valve, and a deep groove, the impression of the tubular canal.

MEASUREMENTS.

Length of a pedicle valve - - - -	14	mm.
Width of a pedicle valve - - - -	12.5	,,
Length of a brachial valve - - - -	11	,,
Width of a brachial valve - - - -	9.5	,,
Length of a large brachial valve (figured) -	14	,,
Width of a large brachial valve (figured) -	14.5	,,

Affinities.—In some respects S. australis seems related to S. anglica, Morris[1], as for example in its relatively large size, the prominent lines of growth, and the pitted shell-surface. Our specimens differ in certain points which render them specifically distinct; it is generally much larger than S. anglica, and it is not so deeply nor so numerously pitted as that species.

Occurrence.—Found in the hard black argillaceous rock, Domain Road, South Yarra (Sewerage Works), [903-609]. Also as casts, in brown micaceous sandstone, Swanston Street Sewer [600-1], and from the Sewerage Tunnel near Old Fish Market, Flinders Street [610-11]. Collected by Mr. F. Spry.

Horizon.—Silurian (Melbournian).

Genus *Orbiculoidea*, d'Orbigny.

Orbiculoidea selwyni, sp. nov. (Pl. X. Figs. 5, 6, 6*a*, 12).

Specific characters.—Pedicle valve broadly elliptical. Apex excentric, situated at less than one fourth the length of the shell

1 Ann. Nat. Hist., 2nd ser., 1849, vol. iv., p. 320, pl. vii., figs. 1*a*-*e*.

from the posterior margin, directed backward. Foramen elliptical, with a post-apical groove which partially interrupts the lines of growth passing down towards the posterior margin, and emerging on the interior in a sipho. Surface gently convex on the anterior slope, abruptly depressed in the post-apical region. Surface with numerous, fine, concentric growth lines. Outline of brachial valve broadly elliptical; apex centric, conical and strongly convex anteriorly, somewhat depressed in the post-apical region, but recovering its convexity near the posterior margin. Concentric lines of growth distinct.

The figure (5) of the pedicle valve is from an obliquely crushed specimen.

MEASUREMENTS.

Length of pedicle valve figured	- -	6.5 mm.
Width of pedicle valve figured	- -	3 ,,
Length of brachial valve figured	- -	6 ,,
Width of brachial valve figured	- -	4.5 ,,
Height of brachial valve figured	- -	1.5 ,,

Observations.—The genus Orbiculoidea has been usually regarded by palaeontologists as a sub-section of Discina, Lamarck. The researches of Mr. W. H. Dall[1], tend to show that the type species of Discini is D. striata, Schumacher sp. (non Sowerby) = D. ostraeoides, Lam., a recent form from West Africa and apparently the only representative of the genus. One of the chief distinctions between Discina and Orbiculoidea, pointed out by Messrs. Hall and Clarke[2], is the relative position of the perforation and and the direction of the pedicle furrow and tube. In Discina the pedicle valve is perforated behind the apex and the pedicle emerges antero-posteriorly. The reverse is the case in Orbiculoidea, the pedicle furrow, situated just below and behind the apex and extending over a greater or less portion of the valve, emerging postero-anteriorly. The furrow terminates in a tubular sipho which nearly reaches the margin of the shell Often there is a callosity surrounding the greater part of the internal tube. This structure is well shown in one of our specimens (Fig. 12).

1 Bull. Mus. Comp. Zool., Harvard College, 1871, vol. iii., No. 1. Hall and Clarke: Palaeontology of New York, 1892, vol. viii., Palaeozoic Brachiopoda, pt. i., p. 121.

2 *Op. cit.*, p. 125.

Messrs. Hall and Clarke have further advocated the advisability of separating the known types of Orbiculoidea into two groups; Orbiculoidea *sensu stricto* would then include the forms which have the pedicle valve convex or flattened, and the brachial valve conical; the sub-genus Schizotreta of Kutorga embracing those forms in which the pedicle valve is conical, and the brachial depressed convex.

The above species is named in honour of the late Dr. A. R. C. Selwyn, under whose auspices this and many other specimens in the Museum were collected, and whose early mapping of Victoria remains as a splendid testimony of conscientious pioneering work.

Occurrence.—The specimens of Orbiculoidea selwyni in the National Museum are from the Geological Survey collections from Merri Creek, Parish of Merriang Bb 6 [613-4]; and from Merri Creek, Kalkallo, Bb 3 [612].

In the former instance they are found in an ochreous coloured sandy and micaceous rock, and in the latter in a fine blue-grey sandstone.

Horizon.—Silurian (? Yeringian).

Genus *Craniella*, Oehlert.

Craniella lata, sp. nov. (Pl. X., Figs. 4, 14).

Specific characters.—Shell sub-quadrangular, moderately large, broader than long. Dorsal surface rising from behind forward to two-thirds the length when it curves steeply to the anterior border. Sides somewhat steeply sloped. The surface of the dorsal valve rather depressed in the central area; marked by one or two striae parallel with the posterior border. The upper valve in the type specimen is practically represented as a cast of the internal surface. The impressions of the posterior adductors are shown as small trigonal depressions; the two sub-centrals are apparently confluent, though not well seen in the specimen, being represented by a crescentic excavation. Faint indications of the vascular sinuses on the steep lateral margins of the specimen, nearly concentric with the lateral shell-margin and emitting secondary branches from both sides.

MEASUREMENTS.

Length of shell - - - - - - -	6.5 mm.
Width - - - - - - - - -	10 „
Greatest height from surface of attachment -	1.5 „

Affinities.—Although the general characters of our specimen come well within the genus, there are no closely related forms among the few species of Craniella yet described.

Probably the nearest allied form is the variable species from the Hamilton group of New York State, namely C. hamiltoniae, J. Hall[1]. Our specimen, however, is much broader, with a longer posterior border, and having concentric rather than strongly sigmoidal sinuses.

Observations.—This genus has hitherto been recorded only from Ordovician (doubtfully) and Devonian strata in North America and Europe, and thus its occurrence for the first time in Australia is further interesting from the fact that it apparently fills in the gap in its geological range, if the Ordovician occurrence can be proved.

Occurrence.—Our example of the above species was found attached to the external surface of a species of Cycloceras, from the fine blue-grey argillaceous rock near the Botanical Gardens, South Yarra, Melbourne. It was found during the work on the Yarra Improvements. Collected by Mr. F. Spry [896].

Horizon.—Silurian (Melbournian).

Genus *Stropheodonta*, J. Hall.

Sub-genus *Leptostrophia*, Hall and Clarke.

Stropheodonta (Leptostrophia) alata, sp. nov.

(Pl. XI., Figs. 6, 7).

Specific characters.—Shell semi-circular, broadly rounded anteriorly, cardinal margins produced and alate at the extremities; width greater than the length, valves depressed plano-convex. Hinge line nearly straight. Denticulations of the cardinal area extending to more than one half the entire length of the hinge. Impression of posterior adductors strong, with a finely grooved

1 See Hall and Clarke, *op. cit.*, pl. iv., l., figs. 3-16.

surface of attachment. Surface of valves concentrically undulate, finely lineated radially from the umbo to the anterior margin; between the radii, the surface upon magnification is seen to be traversed by numerous excessively fine striae. Shell structure, seen in partially decorticated specimens, coarsely punctate.

MEASUREMENTS.

A large specimen	- -	width 44 mm.
		length 23 „
Another specimen	- -	width 28 „
		length 16 „

Affinities.—In outline our species is rather like Stropheodonta ornatella, Davidson sp. (Salter MS.)[1], but the latter has longer valves, and the extremities of the cardinal margin are not so acuminate. The two forms also differ in the character of the surface striae, S. ornatella having them much coarser in the form of primary and secondary riblets.

Another closely related form, and one typical of the sub-genus is Stropheodonta (Leptostrophia) filosa, Sowerby sp., of the Wenlockian and Gotlandian in Europe[2]; especially with regard to its fine ornamentation of radii. The latter species however has the cardinal extremities much less produced, is proportionately longer, and the primary radii are far more numerous.

Occurrence.—North of Lilydale. Specimens presented by the Rev. A. W. Cresswell, M.A. [665-6]; [659]; [1421]. Also Geol. Surv. Vict. B 23, Junction of Woori Yallock and Yarra [657-8]. In both cases the specimens occur in a kind of ochreous mudstone, the rock in the latter instance being much more indurated.

Horizon.—Silurian (Yeringian).

Sub-genus *Brachyprion*, Shaler.

Stropheodonta (Brachyprion) lilydalensis, sp. nov.
(Pl. XI., Fig. 5).

Specific characters.—Shell semi-circular, broadly rounded anteriorly, with the cardinal extremities somewhat produced and

1 Strophomena ornatella (Salter MS.) Davidson, 1871, Brit. Sil. Brachiopoda (Pal. Soc. Mon.). No. 4, p. 309, pl. xliii., figs. 16-20.

2 Orthis filosa, Sowerby, 1839, in Murchison's Silurian System, pl. xiii., fig. 12; Strophomena filosa, Sow., sp., Davidson, 1871, Brit. Sil. Brach., No. 4. p. 307, pl. xliv. figs. 14-20. Stropheodonta (Leptostrophia) filosa, Sow. sp., Hall and Clarke, 1892, Paleontology of New York, Brachiopoda, pt. i. p. 288.

pointed. Brachial valve nearly flat, slightly concave at the anterior margin. Cardinal process rather prominent. Adductor impressions small and faint. Hinge line with indications of denticulae near the umbo. Surface of shell with prominent and numerous radii, fasciculate near the umbo, stronger and bifurcating near the anterior margin; .5 mm. apart in the median area of shell. Between the radii of the umbonal half of the shell there are closely set concentric wrinkles or undulations. Shell structure coarsely punctate. Ventral valve not seen.

MEASUREMENTS.

Length - - - -	20 mm.
Width - - - -	28 „

Affinities.—This species agrees in the details of the surface ornament with Stropheodonta (Brachyprion) varistriata, Conrad[1] from the Lower Helderberg Group, New York; but with regard to the relative shape of the shell all the specimens of the latter species which have been figured appear to be much longer than our specimen in proportion to the width. The posterior adductor impressions in our specimen also differ from those of S. varistriata, being much shorter and broader. The limited extent of the denticulated area of this fossil shows its relationship with the earlier or Silurian types of Stropheodontae for which Professor Shaler proposed the generic or sub-generic term Brachyprion[2].

Occurrence.—North of Lilydale. Presented by Rev. A. W. Cresswell, M.A. [660].

Horizon.—Silurian (Yeringian).

Genus *Strophonella*, J. Hall.

Strophonella euglyphoides, sp. nov. (Plate XI., Figs. 3-6).

Specific characters.—Shell semicircular in outline. Ventral valve concave, slightly convex at the umbo. Dorsal valve flat or slightly hollowed at the umbonal region, and sharply bent back anteriorly. Cardinal extremities produced and pointed,

1 See Hall and Clarke, 1892, Palaeontology of New York Palaeozoic Brachiopoda, pt. i., pl. xiii., figs. 6-16.

2 Bull. Mus. Comp. Zool., 1865, vol. i., p. 63.

more especially in the brachial valve, the margin of which appears to curl round to enclose the edge of the narrower ventral valve. Marginal area of valves crenelate. Surface of valves marked by strong fasciculate radii, about nine in the space of 10 mm. in the central area, these in turn being further subdivided at 5 mm. from the anterior margin; also with transverse, concentric lines which break, to some extent, the continuity of the radii. Muscular areas of both dorsal and ventral valves well-marked and bordered prominently; those of the dorsal elevated and divided by a central ridge.

MEASUREMENTS.

Dorsal valve of a large specimen,	length	-	28 mm.
	width -	-	54 „
	depth about		19 „
A ventral valve - - -	length	-	35 „
	width -	-	45 „

Affinities.—The nearest allied form to the above is undoubtedly Strophonella euglypha, Hisinger sp.,[1] both in shape, structure, and general markings. The chief differences are, the comparative flatness of the ventral valve and the striking geniculation of the dorsal valve and also the larger number of radii in S. euglyphoides. The European species is proportionately longer than the present one, and the concentric undulations on the shell surface more numerous. The muscular areas of the dorsal valve are shorter and deeper in S. euglyphoides.

Occurrence.—North of Lilydale; in a hard ochreous mudstone. Presented by Rev. A. W. Cresswell, M.A. [688-701]. Also Geol. Surv. Victoria, Parish of Yering, sect. 12 [678-81].

Horizon.—Silurian (Yeringian).

Genus *Plectambonites*, Pander.

Plectambonites transversalis, Wahlenberg sp.

Anomites transversalis, Wahl., 1821, Acta Upsal., vol. viii., p. 64, No. 4. Leptaena transversalis, Wahl. sp., Dalman, 1828,

1 Leptaena euglypha, Hisinger, 1819, Antecken, pl. vi., fig. 4. Strophomena euglypha, His. sp., Davidson, 1871, Brit. Silurian Brachiopoda, No. iv. (Pal. Soc. Mon.), p. 288, pl. xl., figs. 1-5. Strophonella euglypha, His. sp., Hall and Clarke, 1892, Pal. N.Y., Palaeozoic Brachiopoda, pt. i., pp. 279, 292.

Vet. Akad. Handlingar, p. 109, pl. i. fig. 4. Davidson, 1871, Brit. Sil. Brach., No. 4 (Pal. Soc. Mon.), p. 318, pl. xlviii., figs. 1-9.

The convex pedicle valve of our specimen is not so strongly globose as that of typical specimens, but in other respects it is quite comparable with the European and American examples. The valve is relieved by eleven fine but distinct and ridgelike radii, between which the shell surface is crossed by about 8-10 very fine radiating lines.

MEASUREMENTS.

About 12 mm. long; 14 mm. wide.

Observation.—P. transversalis is a well-defined and common form in the Niagara group of North America, and in the Silurian (Gotlandian) of the British Islands, the continent of Europe (Norway and Bohemia), and the Island of Gotland.

Occurrence.— In dark bluish limestone, Deep Creek, seven miles S.W. of Walhalla, Gippsland. Presented by Rev. A. W. Cresswell, M.A. [668].

Horizon.—Silurian (Yeringian).

Plectambonites cresswelli, sp. nov. (Pl. XI., Figs. 8-10).

Characters of the ventral valve.—Outline nearly semi-circular, hinge line straight, but little transgressed by the umbo; cardinal extremities angular and not much produced. Sub-globose, nearly as deep as P. transversalis. Surface with about eleven distinct, threadlike radii, the spaces between the riblets occupied by about 9-12 fine parallel striae. The intercostal surface undulate, the depressions curved, concave anteriorly, and at somewhat equidistant intervals, those on the highest part of the valve about .3 mm. apart.

MEASUREMENTS.

Approximate, as the valve is slightly imperfect.

Length - - - -	5.5 mm.
Width - - - -	9 „
Depth of ventral valve -	2.5 „

Observations.—This species resembles in its superficial ornament both Plectambonites corrugata, Portlock sp.,[1] and P. interstrialis, Phillips sp.[2] Our specimen is more globose in the ventral valve than either of the species just mentioned. As regards the ornament P. corrugata has both primary and secondary radii, and from four to seven intercostal striae, whilst the Gippsland species has the costae running the entire length of the valve and the intercostal striae are nearly twice as many. It differs from P. interstrialis in much the same details, and also in having a proportionately longer shell. It is noteworthy that P. corrugata is found in the Llandeilo and Bala series (Ordovician) in the British Islands, and also in Bohemia, whilst P. interstrialis comes from the middle Devonian of Devonshire and the Eifel.

Occurrence.—In a dark blue limestone, having a semi-crystalline appearance due to numerous cleavage surfaces of crinoidal joints and ossicles. Deep Creek, seven miles S.W. of Walhalla, Gippsland. Collected and presented to the National Museum, together with other specimens of much interest from the same locality, by the Rev. A. W. Cresswell, M.A., in whose honour the species is named [669-70].

Horizon.—Silurian (Yeringian).

Genus *Chonetes*, Fischer.

Chonetes melbournensis, sp. nov. (Plate XI., Figs. 2-4).

Specific characters.—Shell transversely elongate, semi-circular in outline; sub-plano-convex. Brachial valve approximately flat or only slightly concave; surface with numerous fine threadlike and radial striae; cardinal process prominent. Pedicle valve with surface traversed by 7 or 8 threadlike radii and numerous finer striations in the interspaces. Sometimes the radii are obsolete, the fine striae alone prevailing. Posterior margin of the pedicle valve bearing about 10 slender spines, often having a

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1 *Orthis corrugata*, Portlock, 1843, Rep. Geol. Londonderry, etc., p. 450, pl. xxxii., figs. 17, 18. *Strophomena corrugatella*, Davidson, 1871, Brit. Sil. Brach., No. iv. (Pal. Soc. Mon.), p. 301, pl. xli., figs. 8-14.

2 *Orthis interstrialis*, Phillips, 1841, Palaeozoic, Foss. of Cornwall, Devon, and West Somerset, p. 61, pl. xxv., fig. 103. *Leptaena interstrialis*, Phil. sp., Davidson, 1865, Brit. Dev. Brach. (Pal. Soc. Mon.), p. 85, pl. xviii., figs. 15-18.

length of half that of the shell, and set almost at right angles to the hinge line, with a slight outward curve. Under a fairly high magnification the shell surface between the striae is seen to be irregularly pitted, and the striae themselves are bridged over by oblique curved cross ridges.

MEASUREMENTS.

An average specimen -	- length	5.7	mm.
	width	10	„
A larger specimen -	- length	7	„
	width	12.5	„
A small specimen -	- length	5	„
	width	8.5	„

Affinities.—The only species with which our specimens appear likely to be confused is Chonetes striatella, Dalman sp.[1] The latter has, however, a more transversely elongate shell, a distinctly concave brachial valve, and spines set at a wide angle with the ventral umbo.

Observations.—McCoy has recorded Chonetes minima, Sow. sp.,[2] from Victoria; and on the maps of the Geol. Surv. of Victoria, Quarter-sheet, No. 3, N.E., in a note on the fossils at Bruce's Creek, near Mount Disappointment, he records Leptaena allied to minima, Sow.;[3] also on Quarter-sheet, No. 4, S.W., at Broadhurst's Creek, S.E. of Kilmore, locality Bb 18, both Chonetes and Leptaena are recorded, as well as a Leptaena at Dry Creek, Bb 19. It is worthy of note that a specimen of Chonetes has been found in the Survey collections at the Museum, labelled as such by McCoy, from locality Bb 18 [874], and this is identical in every respect with Chonetes melbournensis. Whether the Chonetes minima is represented in the Museum collection remains to be discovered, but certain it is that the Broadhurst Creek specimen is not referable to the latter form, which differs in many respects from C. melbournensis in point of size, being much smaller and often less than half the width, in the greater

1 *Orthis striatella*, Dalman, 1827, Kongl. Akad. Handlingar, p. iii., pl. i., figs. 5*a-d*. *Chonetes striatella*, Dalm. sp., Davidson, 1871, Brit. Sil. Brach., No. 4 (Pal. Soc. Mon.), p. 331, pl. xlix., figs. 23-26. Zittel-Eastman, 1900, Text-book of Palaeontology, p. 317, fig. 529A.

2 *Leptaena minima*, Sow., McCoy, in Smyth's Progress Report, 1874, p. 34.

3 In Murchison's Silurian System, 1839, pl. xiii., figs. 4, 4*a*.

concavity of the brachial valve, and in the larger number of radii.

Occurrence.—In the brown and blue hardened clays of Melbourne; South Yarra Improvements [634-8]; South Yarra sewerage tunnel, Domain Road, presented by Mr. F. Spry [630-3]; sewerage tunnel near the Old Fish Market, Flinders Street [1419]; sewerage tunnel, Swanston Street, near the Cathedral [621-7]; Swanston Street, sewer near Collins Street [615-20, 639-43]. Also at Broadhurst's Creek, S.E. of Kilmore, G.S.V. Bb 18 [874].

Horizon.—Silurian (Melbournian).

Chonetes robusta, sp. nov. (Plate XII., Fig. 8).

Specific characters.—Shell semi-circular, wider than long. Cardinal extremities obtusely angular, anterior margin well-rounded. Pedicle valve strongly convex with a shallow median fold; beak slightly projecting. Brachial valve concave, flattened near its cardinal extremities. Shell surface with about 36-40 well-marked, slightly sinuous and sharply ridged radii, which bifurcate close to the anterior margin. A series of hollow spines (probably eight) attached to the cardinal surface of the ventral valve, and arranged nearly perpendicular to the hinge line.

MEASUREMENTS.

Length of figured specimen - -	14 mm.
Width - - - - - - -	20 „

Affinities.—This and the species next to be described belong to de Koninck's group of the Striatae. The general shape and surface characters of this species in some respects resembles Chonetes minima, Sow. sp.[1], a form generally distributed through the Silurian of England and Wales. C. robusta however is altogether a very much larger form, and possesses a distinct median fold. Chonetes acutiradiata, J. Hall, of the Corniferous Limestone (Upper Helderberg—Devonian), of New York is similar in respect to the radii, but the cardinal extremities are much produced. The original figure of C. acutiradiata[2] shows it to differ from our

1 *Loc. supra cit.*

2 *Strophomena acutiradiata*, J. Hall, 1843, Nat. Hist. New York, pt. iv., Geology, p. 171, woodcut 67, No. 3.

species also in the arcuate border of the lateral margins, and its sharp cardinal extremities. The figure of the same species given by Hall and Clarke is more extreme, being short, and transversely elongate, with produced and sub-cylindrical extremities[1].

Occurrence.—In a hardened mudstone crowded with casts and decorticated valves of brachipods and other shells, north of Lilydale. Presented by Rev. A. W. Cresswell, M.A. [1417].

Horizon.—Silurian (Yeringian).

Chonetes cresswelli, sp. nov. (Plate XII., Fig. 7).

Specific characters.—Shell semicircular, hinge line straight, beaks only very slightly projecting; cardinal extremities obtusely angular. Pedicle valve with a well-marked median fold. Radii sharp, more numerous than in the preceding species, averaging about 56 at the margin. Shell-surface marked with one or two faint concentric lines, which do not interrupt the continuity of the radii. Eight or more hollow spines set nearly perpendicular to the cardinal line on the pedicle valve.

MEASUREMENTS.

An average specimen:—Length	- -	9 mm.
Width	- -	15 „

Observations.—The general characters of this and the preceding species are somewhat similar, the chief differences lying in the altogether stouter build of shell and fewer radii in Chonetes robusta. The shell in C. cresswelli is usually more elongate transversely, but is variable in this respect. The faint concentric markings on the valves of the latter form is another distinguishing character.

In the number of the radii the above species is nearly comparable with Chonetes australis, McCoy[2], from the Middle Devonian of Buchan and Lucknow, Gippsland, but there is no mesial sulcus in the pedicle valve of that species; the valve is also longer in proportion and the spines are shorter and stouter.

Occurrence.—This species is found, like the preceding, in the indurated mudstones north of Lilydale associated with Orthis,

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1 *Chonetes acutiradiata*, Hall sp., Hall and Clarke, Palaeontology of New York, Palaeozoic Brachiopoda, vol. iv., pt. 1., pl. xvi., fig. 8.

2 Prodr. Pal. Vict., Decade iv., 1876, p. 17, pl. xxxv., figs. 3-5

Strophonella, Stropheodonta, Leptaena, Pentamerus, Spirifer, Cyrtolites, Bronteus, and many other fossils. Presented by Rev. A. W. Cresswell, M.A. [652-5]; [1422-3].

Horizon.—Silurian(Yeringian).

Genus *Uncinulus*, Bayle.

Uncinulus stricklandi, Sowerby sp.

Terebratula stricklandii, Sowerby, 1839, in Murchison's Silurian System, pl. xiii., fig. 19. Rhynchonella stricklandii, Sow. sp., Davidson, 1867, Brit. Sil. Brach., No. II. (Pal. Soc. Mon.), p. 166, pl. xxi., figs. 1-6 and 28. Uncinulus stricklandi, Sow. sp., Hall and Clarke, 1894, Pal. N. Y., Palaeozoic Brachiopoda, vol. iv., pt. ii., p. 195., pl. lviii., figs. 38-40.

Observations.—The two examples placed on view in the Museum seem to be quite typieal of this species; the median fold is well-defined, the plications are strong and persistent to the umbo, and number about 24 on the pedicle valves.

Measurements.

Length - - - - - -	23 mm.
Width - - - - - -	30 „
Depth of pedicle valve about - -	11 „

Occurrence.—In the hardened mudstone of Yering, Upper Yarra, Geological Survey of Victoria [851-2].

Horizon.—Silurian (Yeringian).

Note to Part I. of this Series.

(Proc. Roy. Soc. Victoria, vol. xv., pt. ii., 1903., pp. 118 and 119).

The specimens of Upper Ordovician slates with Siphonotreta maccoyi which are in the Melbourne National Museum belong to the Geological Survey localities—Ba 62 and 64 as stated in the paper referred to above; but they were from the exposures on the banks of the Saltwater River, about 3 miles N.E. of Diggers' Rest, and not from Deep Creek (a tributary of the former) as one would understand from Professor McCoy's remarks. When

McCoy referred to Deep Creek as the locality for Siphonotreta (Ann. Mag. Nat. Hist., ser. 3, vol. xx., 1867, p. 201) he evidently had in mind the name Deep Creek by which the Saltwater River is sometimes known higher up, near Lancefield, and this possible explanation is further strengthened by McCoy's record of Siphonotreta on the Survey map 7 S.E. at localities Ba 61 to 63, Saltwater River, while Deep Creek has no such record. There is therefore no evident reason for the colouring of the area round Deep Creek as Lower Silurian (Ordovician).

Within the last few weeks I have found in the Museum the Survey specimens collected at the locality marked on the Geological maps Ba 60, Deep Creek; and these consist of pieces of a conglomeratic, and sandy fossiliferous bed. The fossils are represented by casts, internal and external, of corals, mollusca and a tribolite, and their general aspect is that of the Yeringian, or uppermost Silurian, faces. These fossils will shortly be discussed in a separate paper of this series.

Corrigenda to Part I.

P. 107, line 14 from bottom, p. 108, lines 12 and 15 from top, and p. 121, line 14 from top for "proximal" read "distal."

P. 112, line 12 from bottom, for pl. "i." read "xvi."

P. 119, line 2 from top for "Deep Creek" read "Saltwater River."

P. 119, line 13 from top delete "Deep Creek."

P. 121, line 10 from top for "distal" read "proximal."

EXPLANATION OF PLATES X., XI., XII.

Plate X.

Fig. 1.—*Fenestella margaritifera*, sp. nov. Basal aspect of zoarium; natural cast of internal, poriferous, surface. Natural size. [587].

„ 2.—*F. margaritifera*, sp. nov. Natural cast of a portion of the external, non-poriferous, surface. Natural size. [588].

Fig. 3.—*F. margaritifera*, sp. nov. Portion of poriferous surface, showing the arrangment of the zooecia and the tuberculate keel. From a wax impression. × 40. [593].

„ 4.—*Craniella lata*, sp. nov. Dorsal aspect of specimen attached to a Cycloceras. × 2. [896].

„ 5.—*Orbiculoidea selwyni*, sp. nov. Pedicle valve. × 4. [614].

„ 6.—*O. selwyni*, sp. nov. Brachial valve; 6a, ditto, side view. × 4. [612].

„ 7.—*Siphonotreta australis*, sp. nov. Pedicle valve. × 2. [605].

„ 8.—*S. australis*, sp. nov. Apical end of valve showing foramen. × 2. [603].

„ 9.—*Lingula spryi*, sp. nov. ? Ventral valve; 9a, edge view. × 3. [598].

„ 10.—*L. latior*, sp. nov. ? Dorsal valve; 10*a*, edge view. × 3. [597.]

„ 11.—*Fenestella australis*, sp. nov. Portion of zooecial surface including some of the bifurcating branches. × 7. [1205A].

„ 12.—*Orbiculoidea selwyni*, sp. nov. Internal aspect of a pedicle valve, showing the tube partially enclosed by a callus. × 15. [613].

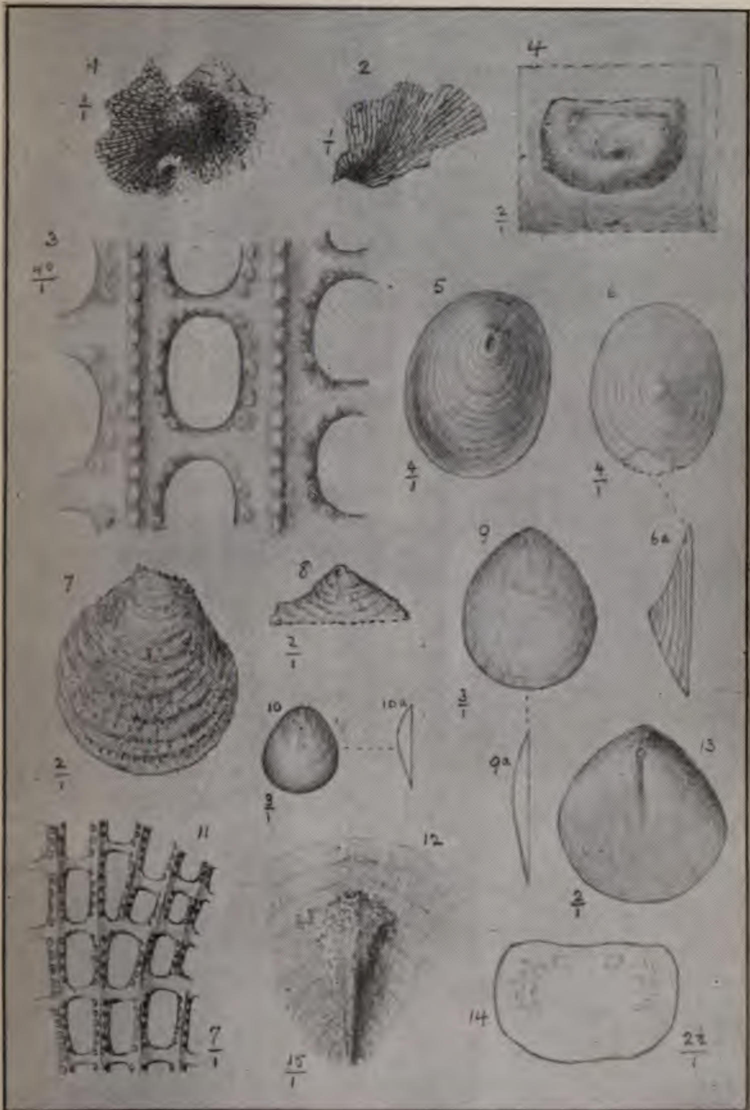
„ 13.—*Siphonotreta australis*, sp. nov. Internal cast of a pedicle valve. × 2. [611].

„ 14.—*Craniella lata*, sp. nov. Outline sketch showing the position and form of the vascular sinuses, with the posterior and sub-central adductor impressions × 2½. [896].

Plate XI.

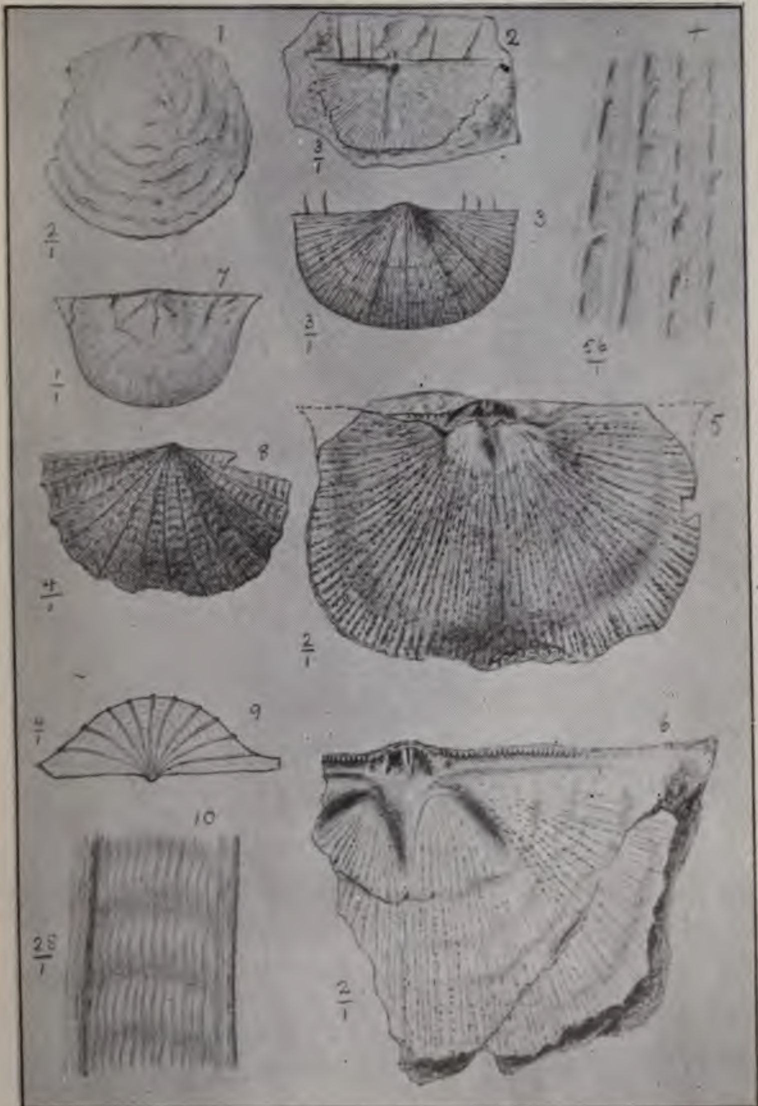
Fig 1.—*Siphonotreta australis*, sp. nov. Brachial valve; a large specimen. × 2. [608]

„ 2.—*Chonetes melbournensis*, sp. nov. Interior of a brachial valve showing cardinal process. The matrix above the hinge line of the shell carries the casts of spines left by the removal of the area of the pedicle valve. × 3. [1419].



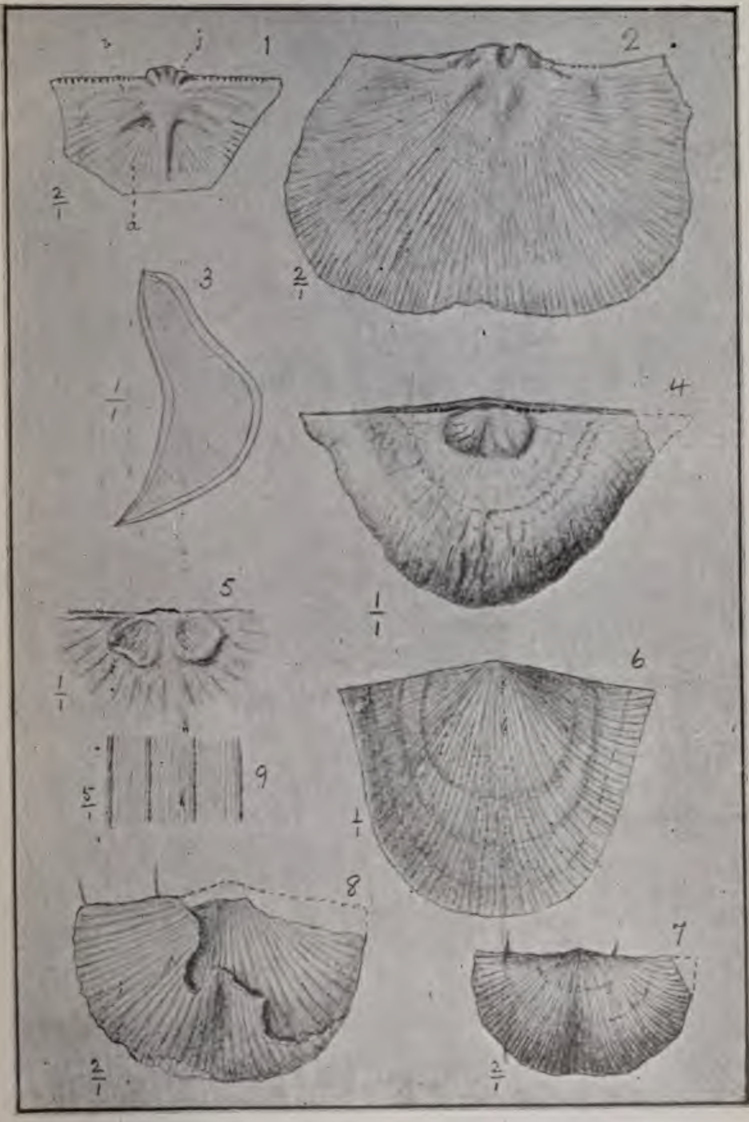
F. C.

Silurian Fossils from Victoria.



F. C.

Silurian Fossils from Victoria.



F. C.

Silurian Fossils from Victoria.

Fig. 3.—*C. melbournensis*, sp. nov. Pedicle valve. × 3. [636].

,, 4.—*C. melbournensis*, sp. nov. Portion of pedicle valve highly magnified, showing pittings and irregular, oblique, transverse ridges. × 56.

,, 5.—*Stropheodonta* (*Brachyprion*) *lilydalensis*, sp. nov. Natural mould of interior of brachial valve with traces of posterior adductor scars in relief, and impression of denticulate hinge. × 2. [660].

,, 6.—*Stropheodonta* (*Leptostrophia*) *alata*, sp. nov. Natural cast of interior of brachial valve with strong adductors. × 2. [665].

,, 7.—*Stropheodonta* (*Leptostrophia*) *alata*, sp. nov. Decorticated pedicle valve. Natural size. [666].

,, 8.—*Plectambonites cresswelli*, sp. nov. Pedicle valve. × 4. [669].

,, 9.—*P. cresswelli*, sp. nov. Cardinal view of pedicle valve. × 4. [669].

,, 10.—*P. cresswelli*, sp. nov. Portion of surface between two riblets, more highly magnified. × 28.

Plate XII.

Fig. 1.—*Stropheodonta* (*Leptostrophia*) *alata*, sp. nov. Positive impression in wax of a natural cast of the interior of a brachial valve; with denticulate hinge line, cardinal process (j), dental sockets, and adductor impressions with grooved surfaces (a). × 2. [665].

,, 2.—*S.* (*Brachyprion*) *lilydalensis*, sp. nov. Interior of brachial valve, from a positive impression in wax. × 2. [660].

,, 3.—*Strophonella euglyphoides*, sp. nov. Profile section showing strong geniculation of the brachial valve. Natural size.

,, 4.—*S. euglyphoides*, sp. nov. Natural cast of interior of brachial valve with deep adductor impressions. Natural size. [694b].

,, 5.—*S. euglyphoides*, sp. nov. Positive cast of preceding specimen, umbonal portion; with grooved adductor impressions, and fine lineation between the radii. × 1½. [694b].

Fig. 6.—*S. euglyphoides*, sp. nov. Pedicle valve. Natural size. [694a].

„ 7.—*Chonetes cresswelli*, sp. nov. Decorticated pedicle valve. × 2. [652].

„ 8.—*C. robusta*, sp. nov. Ventral aspect. The two valves lying in juxtaposition. × 2. [1417].

„ 9.—*Stropheodonta* (*Leptostrophia*) *alata*, sp. nov. Decorticated surface of pedicle valve, showing the interstriate surface. × 5. [1421].

[The numbers in square brackets refer to registered specimens in the National Museum.]

ART. VI.—*On Some Australian Tertiary Pleurotomarias.*

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(With Plates XIII., XIV.).

[Read 14th May, 1903.]

I.—**Pleurotomaria tertiaria**, McCoy. (Pl. XIV., Figs. 1-4).

The first species of the genus Pleurotomaria described from Australian Tertiary deposits is that dealt with by the late Sir F. McCoy, under the name of P. tertiaria,[1] in 1876, and is indicated as, "Rare, in a hard, pink and yellowish limestone, like lithographic stone, ... on the east bank of the Moorabool River, near Maude." This species still remains a rare form, and only imperfect specimens are usually obtained. The range of the species may, however, be extended much further down the valley than the locality indicated by McCoy, the section in soft polyzoal and other limestones below the old Clyde Mill, and on the opposite side of the river to the State School, having yielded fair specimens. These deposits along the valley were originally referred to by McCoy as Miocene,[2] and consequently the Geological Survey mapped them as such.[3] This was subsequently followed by Dr. H. Woodward in his paper on Recent and Fossil Pleurotomariae,[4] and by later writers. This horizon has been referred to as the Upper Maude Beds,[5] and is probably Eocene, the palaeontological evidence clearly requiring a greater antiquity than Miocene.[6]

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1 Prodromus of the Palaeontology of Victoria, Decade III., pp. 23, 24, pl. xxv., figs. 1, 1*a*, 1*b*, 1876.

2 Intercol. Exhib. Essays, 1866-67, No. 7. Recent Zool. and Palaeontology of Vic., pp. 16-19. Also Selwyn, *Id.*, No. 3, Phys. Geog., Geol., and Min. of Vic., pp. 22, 23. Also Prod. Pal. Vic., Dec. III., p. 23.

3 Geological Survey Quarter-sheet, No. 19, S.W., Wilkinson and Murray, 1865.

4 Geol. Mag., n.s., Dec. III., vol. ii., No. 10, Oct., 1885, p. 434.

5 Proc. Roy. Soc. Vic., vol. vii., n.s., pp. 184, 185, 1895.

6 A.A.A.S., Adelaide, 1893, vol. v., pp. 338-343. Proc. Roy. Soc. Vic., vol. vii., n.s., pp. 186-188. Trans. Roy. Soc. S.A., vol. xix., pt. i., p. 121, 1895. A.A.A.S., Brisbane, 1895 vol. vi., pp. 348-361.

McCoy apparently had this species under a different name in manuscript prior to his description of the species, for in the Exhibition Essays, 1866-67,[1] he remarks, "Amongst the singular forms in these Australian tertiary beds recalling oolitic European ones is a Pleurotomaria (P. Australis, McCoy), as large as the mesozoic Pleurotomaria Anglica."

The description given by McCoy of the type of this species is as follows:—"Shell large, trochiform, apical angle 67°; whorls flat, or very slightly convex; base moderately convex, with (?) a small umbilicus; band of moderate width in the middle of each whorl, slightly depressed. Surface with sub-equal prominent thread-like spiral striae, rather less than their thickness apart (about 10 or 11 above, and the same number below the band), about 3 slightly smaller on the band, reticulated by arched striae, narrower, but nearly as prominent as the spiral striae, and slightly further apart. Length about 2 inches 9 lines; proportional width, $\frac{95}{100}$; length of last whorl, $\frac{33}{100}$."

An examination of the type and only specimen of the species possessed by the National Museum, Melbourne, shows it to be only poorly preserved, and considerably chipped in the removal of the matrix; and unfortunately McCoy saw fit to figure a restoration and not the actual specimen, with the result that the figure is inaccurate in several details, and the enlargement of the sculpture is very misleading.

The figures then not being exact, and the description being very brief and too general, new species might very easily have been made out, but for the type being accessible.

A well-preserved specimen, but unfortunately somewhat broken about the apex and aperture, has been very kindly lent to me by the Rev. A. W. Cresswell, M.A., and proves to represent P. tertiaria, McCoy; the exact locality from which it was obtained has been forgotten, but judging by the calcareous sandy clay matrix, and since it was thought to come from the Geelong District, there is very little doubt but that the specimen was obtained either from the lower portion of the Moorabool Valley or perhaps from Corio Bay.

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1 Essay, No. 7, Rec. Zool. and Pal. of Vic., p. 18.

Through the kindness of Mr. J. A. Kershaw, Curator of the National Museum, Melbourne, and Mr. F. Chapman, Palaeontologist, I have been able to compare this specimen with McCoy's type, and they agree with me that there is no doubt about their specific identity. The preservation of the shelly material of Mr. Cresswell's specimen is far better than that usually met with in the limestones, casts and impressions being the most frequently obtained under those conditions, consequently the sculpture can be very distinctly and critically examined, and as there are several points of difference from McCoy's figures and description, it might be well to refer to them. The apical angle is practically the same, being only a degree or two less, the whorls are slightly convex above the band, depressed at the band, flat or slightly concave below the band, earlier whorls rather flatter than later; the base is convex becoming depressed towards the periphery, it is faintly spirally and radially striate, the latter marking being somewhat sigmoid, the base is *not* umbilicate, but the columella is strong and twisted; aperture quadrate; the band is about 1.5 mm. wide on a whorl of 14 mm. width; strong spiral threads irregular in width occur on the earlier whorls, but gradually fade out till they become mere striations, there is usually one less above the band than below it and they increase in number as the whorls increase; the arched striae crossing the spiral threads are strongest near the posterior suture and their general trend is at a much more acute angle to the band than the much fainter striae below the band; the earlier whorls from this sculpture show quite a tessellation, but this disappears before the body whorl is reached. McCoy's enlargement of the sculpture shows 12 threads above the band and 12 below, but the type does not show this, there being actually fewer, and also a difference of one above and below the band, nor is the tesselation as regular as figured, while the arched striae in figure 1 are entirely erroneous.

II.—**Pleurotomaria bassi**, sp. nov. (Pl. XIII., Figs. 1, 2).

Recently I obtained a very large specimen of this genus from the Eocene beds of Table Cape, Tasmania, and though not very perfect, through weathering of portion of one side, there appears sufficient character to distinguish it as a new species.

Description.—Shell very large, trochiform, apical angle about 75 degrees, rather lacking in solidity considering its size. Whorls slightly convex, with a well impressed suture, earlier whorls rather flat, impressed suture less marked; whorls rapidly increasing in size, and numbering about nine. The median band is broad, being in width about one-sixth the height of the whorl, it is very strongly marked, and is situated a little below the middle of each whorl. Body-whorl strongly keeled at the base; base very slightly convex to a well-marked umbilicus, which penetrates only to the penultimate whorl; aperture subquadrate, posterior portion of the lip thin, lower edge of the lip slightly thickened and rounded off, becoming thicker and more solid towards the columella, the latter being strikingly more solid and robust than the rest of the shell.

There is evidence of faint spiral striae, irregular in strength, on the upper or posterior portion of the penultimate and body-whorls, and a faint spiral striation is discernible on the base, becoming a little clearer and closer towards the umbilicus; the general character of the surface-marking being a rude and irregular striation in conformity with the lines of growth, the base also showing a strong irregular undulation parallel to the growth.

Dimensions.—Basal diameter, 5⅜ inches, or 136 mm.; height from the base, 4⅛ inches, or 103 mm.; breadth of aperture, 3 inches or 75 mm.; depth of aperture, about 1½ inches, or 36 mm.; width of fasciole, near slit, 6 mm. to 5 mm. further back on the body-whorl; length of slit, 48 mm.

Locality.—Basal horizon of the Table Cape Beds, Tasmania, in coarse ferruginous grits. Jan Jukian (Eocene).

Observations.—The large size of this species is worth special note as it compares very favourably with the largest of the specimens yet obtained of P. adansoniana, Crosse and Fischer, the best known of the recent species. The thinness of the shell is rather remarkable, especially in view of the coarse gritty material in which it is preserved, and in this respect it is scarcely as thick as the much smaller species of McCoy, in addition to this feature it differs from P. tertiaria, in its greater apical angle, the more impressed sutures, in its umbilicus, and in its inornate character. The shortness of the slit, and the

remarkable breadth of the fasciole, and lack of sculpture, are features worthy of special attention in this new species.

III.—Pleurotomaria, n.sp.

A new species of Pleurotomaria was recorded by the late Professor R. Tate in his list of the Eocene fossils from Cape Otway,[1] and this is subsequently included in M. Vincent's list of Eocene species of this genus,[2] but I am unaware of any published remarks, description, or figure of this form, and not having seen the specimen, I am unable to give any further information concerning it.

Very imperfect specimens of a high spired form of this genus have been obtained from the Eocene limestones of Waurn Ponds, near Geelong, by Mr. T. S. Hall and myself, but the material yet to hand is too meagre to permit of specific determination.

Our Tertiary representation of this genus appears to be exceptionally good when compared with that of other countries, but before noting the other Tertiary records, there are some points of relationship and classification upon which I would like to comment.

Fischer has divided the recent species into two sections, Perotrochus, typified by P. quoyana, Fischer and Bernardi, and Entemnotrochus, typified by P. adansoniana, Crosse and Fischer.

Perotrochus has been defined as:—Form conical, base not umbilicate, whorls striate or granulate, anal fasciole sub-median or below the middle, slit short.

While Entemnotrochus is characterised as follows:—Shell conoidal, striate, umbilicate; anal fasciole a little above the middle of the upper surface of the last whorl, slit long, but not exceeding the half of a whorl.

McCoy remarks of P. tertiaria[3] that it "is almost intermediate in character between the two living ones," the two referred to being P. quoyana, and P. adansoniana.

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1 Trans. Roy. Soc. South Australia, vol. xix., pt. i., p. 112, 1895.

2 Soc. Roy. Malac. de Belg., vol. xxxi., 1896, but not distributed till 24th December, 1899, p. 56.

3 Prod. Pal. Vic., Dec. iii., p. 23.

P. bassi shows some affinity with P. beyrichi, Hilgendorf, in that the fasciole is broad, and is situated a little below the middle of the body-whorl, and the slit is short, in these and other respects it appears to agree with Fischer's section Perotrochus, but it is distinctly umbilicate. Thus if relationship with the recent forms be pushed, P. bassi would also appear to be an intermediate form, and this taken with the P. tertiaria characters, would tend to invalidate Fischer's divisions of the recent forms. On the other hand much closer relationship can be made out with Jurassic and Cretaceous forms for both our fossil species, and this is in direct accord with the position of most other Eocene species in other parts of the world, and may perhaps be taken as a small additional piece of evidence in favour of the Eocene age of the deposits containing them.

P. tertiaria McCoy may probably belong to Leptomaria, but P. bassi certainly does not, and shows rather more affinity with Jurassic forms.

Special interest attaches to this genus as a "persistent type," and on account of its rarity living at the present time, and fossil in Tertiary deposits, as compared with its numerous fossil representatives from older geological deposits ranging up from Silurian.

There are five recent species of which there are only about twenty-three or twenty-four specimens known.

1856. Pleurotomaria quoyana, Fischer and Bernardi.
1861. Pleurotomaria adansoniana, Crosse and Fischer.
1877. Pleurotomaria beyrichi, Hilgendorf.
1879. Pleurotomaria rumphii, Schepman.
1899. Pleurotomaria salmiana, Rolle.

Including the present new species, P. bassi, the number of Tertiary species recorded is twenty, but one at least of these is unknown by any figure or description and ought hardly to be taken into consideration. The remaining nineteen are all very rare, and the majority are recorded from Eocene beds. Altering the age ascribed to P. tertiaria, McCoy, from Miocene to Eocene, the species are distributed as follows :—

Eocene	-	14 species.
Miocene	-	2 species.
Pleistocene	-	3 species.

List of the Tertiary Species of Pleurotomaria.

Eocene.

1853. Pleurotomaria bianconii, d'Archiac, India.
1864. Pleurotomaria concava, Deshayes, Paris Basin.
Pleurotomaria duboisii, Mayer, Crimea = Trochus giganteus, Dubois, non Sowerby.
Pleurotomaria genyi, Mayer, Nice.
1866. Pleurotomaria kadin-kewiensis, d'Archiac, Asia Minor.
Pleurotomaria lamarckii, Mayer, Switzerland.
Pleurotomaria nicaeensis, Bayan, Nice.
1854. Pleurotomaria nixus, Tuomey (Trochus), North Carolina.
1865. Pleurotomaria perlata, Conrad, New Jersey.
1896. Pleurotomaria (Leptomaria) whitfieldi, Vincent, New Jersey = gigantea, Whitfield, non Sowerby.
1892. Pleurotomaria (Leptomaria) pergranulosa, Whitfield, New Jersey.
1896. Pleurotomaria (Leptomaria) landinensis, Vincent, Belgium.
1876. Pleurotomaria tertiaria, McCoy, Moorabool Valley, Victoria.
1903. Pleurotomaria bassi, Pritchard, Table Cape, Tasmania.

Miocene.

Pleurotomaria sismondai, Goldfuss, Bunde.
1892. Pleurotomaria atlantica, Cotter, Santa Maria, Azores.

Pleistocene.

Pleurotomaria fischeri, Mayer MS., Guadaloupe.
1869. Pleurotomaria duchassaingii, Schramm, Guadaloupe.
1821. Pleurotomaria gigas, Borson, Italy.

Regarding P. fischeri, Mayer, M. Crosse in 1882 refers to it as a MS. name.[1] And later again in Bouvier and Fischer's fuller account of the Pleurotomarias in 1899,[2] it is still referred to as an MS. name. Subsequent to 1899 I have found no reference to a description of this species.

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1 Jour. d. Conch., Mon. Pleurotomaria, 1882.
2 Jour. d. Conch., vol. xlvii., pp. 77-151, 1899.

Dall says of P. perlata, Conrad, that it is an ill-defined species, and apparently scarcely recognisable.[1] Bouvier and Fischer in the monograph referred to also refer P. gigas, Borson, and P. atlantica, Cotter, both to the recent section Entemnotrochus, and are inclined to the opinion that these two species are identical.

Concerning P. sismondai, Goldfuss, Crosse and Fischer state[2] that the exact locality of the shell appears doubtful, it is given as the Upper Marine Sands of the neighbourhood of Bunde.

In the description of P. bianconii, d'Archiac, the author queries his generic location of this species in the text, but not on his plate.

P. duboisii, Mayer, was first described as Trochus giganteus. Dubois, and as that specific name was preoccupied, it was named after Dubois by Mayer.

P. whitfieldi, Vincent, has also been treated in a similar way by Vincent, for this species was first described as P. gigantea, Whitfield; this name, as in the previous case, being preoccupied by Sowerby for a Lower Greensand fossil, a change was necessary.

Our total information then on these Tertiary species appears to be of a somewhat meagre order, and if it is accepted that one of the American species is not recognisable, that P atlantica and P. gigas are identical, and that P. fischeri is only a MS. name, our total number dwindles to sixteen, and the amount of readily-available information on several of these is so slight, that further details concerning them and their occurrence would be very acceptable.

Of forms older than Tertiary, about twelve hundred species are known, and these are about equally divided between the Palaeozoic and Mesozoic, but the Jurassic undoubtedly holds the maximum with about four hundred species.

I wish to express my thanks to Professor W. Baldwin Spencer, Director of the National Museum, for allowing me to refigure the type of P. tertiaria, and to Mr. F. Chapman for kindly photographing it.

1 Trans. Wag. Inst., Philad., vol. iii., pt. 2, p. 423, 1892.
2 Jour. d. Conch., vol. ix., p. 162, 1861.

D. W. Paterson, *Photo.*

AUSTRALIAN TERTIARY PLEUROTOMARIAS.

D. W. Paterson, Photo.

AUSTRALIAN TERTIARY PLEUROTOMARIAS.

EXPLANATION OF PLATES XIII. AND XIV.

PLATE XIII.

Fig. 1.—Pleurotomaria bassi, sp. nov. Side view, showing band and position of slit; a little over one-half natural size. Eocene, Table Cape.

Fig. 2.—Pleurotomaria bassi, sp. nov. Basal aspect, showing mouth and umbilical region; nearly four-fifths natural size. Eocene, Table Cape.

PLATE XIV.

Fig. 1.—Pleurotomaria tertiaria, McCoy. Front view, slightly reduced. Eocene, ? Corio Bay or Lower Moorabool Valley.

Fig. 2.—Pleurotomaria tertiaria, McCoy. Basal aspect, slightly reduced. Eocene, ? Corio Bay or Lower Moorabool Valley.

Fig. 3.—Pleurotomaria tertiaria, McCoy. Apical aspect, slightly reduced. Eocene, ? Corio Bay or Lower Moorabool Valley.

Fig. 4.—Pleurotomaria tertiaria, McCoy. McCoy's Type specimen from Moorabool Valley, Upper Maude beds. Specimen in the National Museum, Melbourne.

Art. VII.—*On Some New Species of Victorian Mollusca, No. 6.*

By G. B. PRITCHARD and J. H. GATLIFF.

(With Plate XV.).

[Read 11th June, 1903.]

The present paper includes descriptions and figures of the following species:—

Zenatia victoriae, sp. nov.
Modiola victoriae, sp. nov.

Also observations on our commonest species of Chione, together with figures of the same, namely:—

Chione strigosa, Lamarck.
Chione scalarina, Lamarck.
Chione peronii, Lamarck.

We have to thank Messrs. D. W. Paterson, senior and junior, for the care bestowed on the photographs of these shells, and on their reproduction.

Zenatia victoriae, sp. nov. (Pl. XV., Fig. 3).

Description.—Shell elongate-oval, thin and compressed, with a full and well-rounded anterior end, and slightly attenuate both ventrally and dorsally towards the posterior end. Shell greyish-white and shining, where not covered by a light greyish-brown fine longitudinally striate epidermis, which is very thin and glossy.

Umbos small and well-defined and situated at a distance of one-third of the length of the shell from the anterior margin. Ventral margin nearly straight, only slightly sinuated.

The surface of the valves is very finely concentrically striated, the regularity of the striae being interfered with by the lines of growth, the concentric sculpture is also delicately radially striate, and this is distinctly visible under a lens.

Interior white, cardinal teeth, two and one rudimentary posterior lateral in each valve; the lineal groove of the cartilage plate makes an angle of 20 to 30 deg. with the posterior hinge line; the internal thickening below the umbo or transverse ossicle

forms at first a strong convex ridge, which gradually flattens and spreads out to a distance from the umbo of two-thirds of the height of the shell, and inclines slightly forward towards the anterior.

Dimensions.—Antero-posterior diameter, 73 mm.; umbo-ventral diameter, 31 mm.; anterior margin, from umbo-ventral diameter, 24 mm.; thickness through both valves, about 10 mm.

Locality.—Port Albert (Mr. T. Worcester).

Observations.—This species might at first sight be taken for Zenatia acinaces, Quoy and Gaimard, but it is a good species, and shows many points of difference. The most striking difference is the position of the umbo, which in our new species is at one-third of the length of the shell from the anterior margiu, while in Z. acinaces its position is about one-fifth the length of the shell; this gives a much larger and more regularly rounded anterior to our shell, and consequently a change in the relative position of the anterior muscular impressions, the cartilage plate, and the transverse ossicle. Z. acinaces also has a straighter dorsal margin, and a more marked ventral sinus, and greater proportional height.

Type in Mr. Gatliff's collection.

Modiola victoriae, sp. nov. (Pl. XV., Figs. 1, 2).

Description.—Shell elongate-oblong, tumid, with broad umbonal region, a broad and well-marked anterior, and a posterior rather remarkable for its uniformity of height; ventral margin but slightly sinuated, but the shell in this region above the margin is distinctly constricted. Umbos tumid, only slightly separated, and strongly incurved towards the anterior; lunule ill-defined, scarcely excavated; anterior margin regularly convex from the umbos to the ventral margin, post-dorsal margin short and convexly rounded to the posterior margin. The absence of any angulation in the outline is a distinct characteristic.

The colour is a rich dark brown, with the umbo-ventral convex keel of a lighter shade. The surface is marked by irregular lines of growth and fine parallel striae, with faint radial striae on the anterior region, tending to become obsolete posteriorly.

Dimensions.—Antero-posterior diameter, 40 mm.; umbo-ventral diameter, 18 mm.; greatest height at the middle diameter, 19 mm.; thickness through both valves, 18 mm.

Locality.—Dredged alive from about 6 fathoms off Rhyll, Phillip Island, Western Port.

Observations.—This form may be readily distinguished from our other species of this genus by its regular tumidity, and its remarkable uniform height.

Type in Mr. Gatliff's collection.

OBSERVATIONS ON OUR COMMONEST SPECIES OF CHIONE.

Representatives of the genus Chione are particularly common on many parts of the shores of Port Phillip, but there are three well-marked forms which require special treatment owing to the confusion existing as to their correct naming.

These species are the following :—

Chione strigosa, Lamarck.
Chione scalarina, Lamarck.
Chione peronii, Lamarck.

The most abundant form is commonly referred to as C. strigosa, Lamarck, and this may be identified by its enlongate-ovate form, anastomosing concentric ridges, which are distinctly crossed by continuous radiating striae.

The next most frequently met with is usually known as C. scalarina, Lamarck, and this differs from C. strigosa by its more attenuate posterior, by its regular concentric ridges developing into lamellae anteriorly and posteriorly, and the absence of the radiating striae.

The third form to which we consider Lamarck's name C. peronii properly belongs, may be identified by its more inflated form and flattened concentric ridges.

All these forms vary in colour both externally and internally, each form being sometimes colourless externally, in fact so great is the variation on different points, that but for the above apparently constant characters they might nearly be regarded as extreme variations of one species.

We give in the succeeding part of our Catalogue of the Marine Shells of Victoria, Part VII., a limited number of references to these species, which we consider in each case refers to the same

D. W. Paterson, Photo.

form, with references to figures which should ensure an identification, and we would recommend the adoption of the three names given.

We have, however, thought it advisable to re-figure these species from specimens which we consider will show the points we have laid stress upon to assist in future identification. In arriving at this conclusion we have considered the following Lamarckian species:—

Venus strigosa.	Venus conularis.
Venus scalarina.	Venus aphrodina.
Venus peronii.	Venus aphrodinoides.
Venus tristis.	Venus elegantina.

And the whole confusion surrounding these is due to different grouping of the above by subsequent authors.

Tenison-Woods in his census of Tasmanian shells includes Venus (Chione) humphreyi, Donovan, but the species has not been dealt with by Messrs. Tate and May in their recent census, examples forwarded to us as this species lead us to the conclusion that it falls in with the above series.

Plate XV.

Fig. 1.—Modiola victoriae, sp. nov. Dorsal aspect, natural size.

Fig. 2.—Modiola victoriae, sp. nov. Side view, natural size.

Fig. 3.—Zenatia victoriae, sp. nov. Right and left valve, slightly reduced.

Fig. 4.—Chione strigosa, Lamarck. Paired valves.

Fig. 5.—Chione strigosa, Lamarck. Paired valves of a smaller specimen.

Fig. 6.—Chione strigosa, Lamarck. Paired valves showing strong colour markings.

Fig. 7.—Chione scalarina, Lamarck. Paired valves of a fair sized specimen.

Fig. 8.—Chione scalarina, Lamarck. Paired valves showing colour markings.

Fig. 9.—Chione peronii, Lamarck. Paired valves of rotund form.

Fig. 10.—Chione peronii, Lamarck. Paired valves showing colour markings.

ART. VIII.—*Catalogue of the Marine Shells of Victoria.*

PART VII.

By G. B. PRITCHARD AND J. H. GATLIFF.

[Read 11th June, 1903].

The present paper refers to ninety-seven species of bivalves, contained in the following families :—Gastrochaenidae, Clavagellidae, Teredidae, Pholadidae, Solenidae, Saxicavidae, Corbulidae, Anatinidae, Mactridae, Mesodesmatidae, Semelidae, Tellinidae, Donacidae, Petricolidae, Veneridae, Cardiidae, Chamidae, and Lucinidae.

The previous papers, Parts I. to VI., dealt with the Cephalopoda and Gastropoda, and referred to 531 species, so that with the addition of the present part, which forms the first portion of the Lamellibranchiata, the total now stands at 628 species.

Family GASTROCHAENIDAE.

Genus **Gastrochaena**, Spengler, 1783.

GASTROCHAENA TASMANICA, T. Woods.

1877. Gastrochaena tasmanica, T. Woods. P.R.S. Tas., p. 159.

1878. Gastrochaena tasmanica, Angas. P.Z.S. Lond., p. 869, No. 56.

1887. Gastrochaena tasmanica, Tate. T.R.S. S.A., vol. ix., p. 81, pl. 5, f. 10*a*, *b*.

Hab.—Schnapper Point, Port Phillip (Nat. Mus.).

Family CLAVAGELLIDAE.

Genus **Clavagella**, Lamarck, 1807.

CLAVAGELLA AUSTRALIS, Sowerby.

Clavagella australis, Sowerby. In Stutchbury's Catalogue, pl. 1, f. 1.

1872. Clavagella australis, Reeve. Conch. Icon., vol. xviii., pl. 2, f. 4*a*, *b*, *c*, *d*.

1884. Clavagella (Dacosta) australis, Tryon. Struct. and Syst. Conch., vol. iii., p. 119.

1895. Clavagella australis, Clessin. Conch. Cab., vol. xi., Gastrochaena, p. 22, No. 8, pl. 9, f. 7-10.

Hab.—Victoria (Prof. R. Tate).

Genus Humphreyia, Gray, 1858.

HUMPHREYIA STRANGEI, A. Adams.

1852. Aspergillum strangei, A. Adams. P.Z.S. Lond., p. 91, pl. 15, f. 5.

1858. Humphreyia strangei, Gray. P.Z.S. Lond., p. 317.

1878. Humphreyia strangei, Angas. P.Z.S. Lond., p. 869, No. 55.

1878. Humphreyia strangei, T. Woods. P.R.S. Tas., p. 47.

1884. Humphreya strangei, Tryon. Struct. and Syst. Conch., vol. iii., p. 118, pl. 104, f. 44.

1895. Aspergillum strangei, Clessin. Conch. Cab., vol. xi., Gastrochaena, p. 34, No. 19, pl. 10, f. 4.

Hab.—Flinders to Balnarring, dredged alive, 5 to 8 fathoms, shell-sand bottom, off Rhyll, Phillip Island, and San Remo, Western Port. Rare in Port Phillip.

Family TEREDIDAE.

Genus Nausitora, Wright, 1864.

NAUSITORA SAULII, E. P. Wright.

1865. Nausitora saulii, E. P. Wright. Trans. Lin. Soc. Lond., vol. xxv., pl. 65, f. 9-15.

1875. Teredo saulii, Reeve. Conch. Icon., vol. xx., pl. 3, f. 10*a*, *b*, *c*, *d*.

1884. Teredo saulii, Sowerby. Thes. Conch., vol. v., p. 123, pl. 469, f. 18.

1889. Teredo fragilis, Tate. T.R.S. S.A., vol. xi., p. 60, pl. 11, f. 13*a*, *b*, *c*.

1893. Teredo saulii, Clessin. Conch. Cab., vol. xi., pt. 23, p. 70, No. 10, pl. 17, f. 7-9.

1898. Calobates saulii, Hedley. P.L.S. N.S.W., vol. xxiii., p. 94, f. 7-9.

1901. Nausitoria saulii, Hedley. Rep. Aust. Ass. Adv. Sci., vol. viii., p. 248.

Hab.—Port Melbourne, Beaumaris, Mornington, Port Phillip.

Obs.—This species has been misquoted from Callao, whereas the original locality for the specimens was Port Phillip, Victoria. It has since had its range extended to Sydney, Adelaide and Launceston.

NAUSITORA THORACITES, Gould.

1856. Calobates thoracites, Gould. Proc. Boston Soc. Nat. Hist., vol. vii., p. 15.

1865. Calobates australis, Wright. Trans. Lin. Soc. Lond., vol. xxv., p. 564, pl. 64, f. 1-5.

1893. Teredo thoracites, Clessin. Conch. Cab., vol. xi., Pholas., p. 76, No. 23, pl. 19, f. 1-6.

1893. Teredo australis, Clessin. *Id.*, No. 24, pp. 77, 78, pl. 20, f. 1-3.

1901. Nausitoria thoracites, Hedley. Rep. Aust. Ass. Adv. Sci., vol. viii., p. 247.

Hab.—Specimens from drift timber from Lakes Entrance, Gippsland, in the Engineering School, Melbourne University, identified by Mr. T. S. Hall.

NAUSITORA EDAX, Hedley.

1894. Teredo edax, Hedley. P.L.S. N.S.W., vol. ix., pp. 501-505, pl. 32, f. 1-5.

1901. Nausitoria edax, Hedley. Rep. Aust. Ass. Adv. Sci., vol. viii., p. 248, pl. 9, and pl. 10, f. 5.

Hab.—Drift-timber, Balnarring, Western Port.

Family PHOLADIDAE.

Genus Barnea, Risso, 1826.

BARNEA AUSTRALASIAE, Sowerby.

Barnea australasiae, Gray. MS.

1849. Pholas australasiae, Sowerby. Thes. Conch., vol. ii., p. 488, sp. 11, pl. 107, f. 73.

1865. Barnea australasiae, Angas. P.Z.S. Lond., p. 643.

1872. Pholas australasiae, Reeve. Conch. Icon., vol. xviii., pl. 3, f. 11.

1893. Pholas (Barnea) australasiae, Clessin. Conch. Cab., vol. xi., Pholas, p. 21, pl. 6, f. 2.

Hab.—Port Phillip; Western Port; Anderson's Inlet (W. H. Ferguson); Portland (Maplestone).

Obs.—This species at present appears to be very much rarer in Hobson's Bay and along the Bay between St. Kilda and Sandringham than it was a few years back.

BARNEA OBTURAMENTUM, Hedley.

1893. Pholas obturamentum, Hedley. Records Austr. Mus., vol. ii., No. 4. pp, 55-57, pl. 14, f. 1, 2, 3.

Hab.—Hobson's Bay and Port Phillip generally; Western Port; Portland (Maplestone); Loutit Bay, Lakes Entrance (Nat. Mus.).

Obs.—Mr. Hedley in the above paper was the first to clear up the difficulties surrounding this species, in that up to the time of his dealing with the matter it had been usually referred to as Barnea similis, Gray.

Family SOLENIDAE.

Genus **Solen**, Linnaeus, 1757.

SOLEN VAGINOIDES, Lamarck.

1818. Solen vaginoides, Lamarck. Anim. S. Vert., vol. v., p. 451, No. 3.

1819. Solen vaginoides, Lamarck, *Id.*, vol. vi., p. 54, No. 3.

1839. Solen vaginoides, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 521, No. 3.

1841. Solen vaginoides, Delessert. Recueil de Coq., No. 3, pl. 2, f. 3*a*, *b*.

1842. Solen vaginoides, Hanley. Cat. Rec. Biv. Shells, p. 11.

1874. Solen vaginoides, Reeve. Conch. Icon., vol. xix. pl. 5, f. 23.

1888. Solen vaginoides, Clessin. Conch. Cab., vol. xi., Solen, p. 16, No. 17, pl. 7, f. 2.

Hab.—Altona Bay, Portarlington, Portsea, Port Phillip; Western Port; Portland (Maplestone).

Obs.—Hanley says S. corneus, Wood (non Lamarck), is a synonym of this species, but the figure given represents a much straighter shell than ours. Wood, Index Test. Sup., pl. 1, f. 2.

Family SAXICAVIDAE.

Genus Saxicava, Bellevue, 1802.

SAXICAVA AUSTRALIS, Lamarck.

1819. Corbula australis, Lamarck. Anim. S. Vert., vol. vi., p. 153, No. 1.

1839. Corbula australis, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 547, No. 1.

1875. Saxicava australis, Reeve. Conch. Icon., vol. xx., pl. 2, f. 8.

1880. Saxicava australis, Hutton. Man. N.Z. Moll., p. 134.

1884. Saxicava australis, Sowerby. Thes. Conch., vol. v., p. 132, pl. 471, f. 2.

1895. Saxicava australis, Clessin. Conch. Cab., vol. xi., Gastrochaena, p. 40, No. 4, pl. 6, f. 1-4.

Hab.—A common species on our coast, showing great variation in shape and size, occasionally attaining to upwards of an inch in length even in Hobson's Bay.

Genus Panopaea, Menard de la Groye, 1807.

PANOPAEA AUSTRALIS, Sowerby.

1824? Panopaea australis, Sowerby. Genera, pl. 40, f. 2.

1839. Panopaea australis, Lamarck. Anim. S. Vert. (3rd ed. Deshayes and Edwards), vol. ii., p. 525, No. 3.

1842. Panopaea australis, Reeve. Conch. Syst., vol. ii., pl. 27, f. 2.

1842. Panopaea australis, Hanley. Cat. Rec. Biv. Shells, p. 18, pl. 9, f. 24 (in explanation of plate, p. 2, referred to erroneously as No. 25).

1873. Panopaea australis, Reeve. Conch. Icon., vol. xix., pl. 6, f. 11.

1895. Panopaea australis, Clessin. Conch. Cab., vol. xi., Gastrochaena, p. 51, No. 10, pl. 19, f. 1.

Hab.—San Remo (Miss Stirling); Portland (Maplestone).

Family Corbulidae.

Genus Corbula, Bruguière, 1792.

Corbula scaphoides, Hinds.

1843. Corbula scaphoides, Hinds. P.Z.S. Lond. p. 56.

1844. Corbula scaphoides, Reeve. Conch. Icon., vol. ii., pl. 3, f. 24.

1885. Corbula scaphoides, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 32, pl. 7, f. 3-3*b*.

Hab.—Port Phillip; Western Port; Port Albert; Corio Bay (J. F. Mulder); Hobson's Bay.

Corbula tunicata, Hinds.

1843. Corbula tunicata, Hinds. P.Z.S., Lond., p. 55.

1844. Corbula tunicata, Reeve. Conch. Icon., vol. ii., pl. 1, f. 5.

1868. Corbula tunicata, Tyron. Amer. Jour. Conch., vol. iv., App., p. 66.

1885. Corbula tunicata, E. A. Smith. Chall. Zool., vol. xiii., Lam. p. 29.

Hab.—Portland; Port Albert; Snake Island; Western Port.

Corbula cuneata, Hinds.

1843. Corbula cuneata, Hinds. P.Z.S. Lond., p. 55.

1844. Corbula cuneata, Reeve, Conch. Icon., vol. ii., pl. 4, f. 33.

Hab.—Portland.

Family Anatinidae.

Genus Myodora, Gray, 1840.

Myodora brevis, Sowerby.

Pandora brevis, Sowerby. App. Stutchbury's Cat., p. 3, f. 2.

1835. Anatina brevis, Stutchbury. Zoo. Jour., vol. v., p. 99, Tab., Sup., 43, f. 1, 2.

1842. Myodora brevis, Hanley. Cat. Rec. Biv. Shells, p. 24.

1844. Myadora brevis, Reeve. P.Z.S. Lond., p. 93.

1844. Myadora brevis, Reeve. Conch. Icon., vol. ii., pl. 1, f. 7*a*, *b*.

1856. Myodora brevis, Hanley. Cat. Rec. Biv. Shells, pp. 338, 339, pl. 10, f. 13.

1862. Myodora brevis, Chenu. Man. Conch., vol. ii., p. 52, f. 217.

1880. Myodora brevis, E. A. Smith. P.Z.S. Lond., p. 580, No. 3.

1885. Myodora brevis, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 64.

Hab.—Hobson's Bay; Port Phillip; occasionally very large specimens up to an inch and a half in diameter obtained by dredging, also generally distributed along the coast at favourable parts.

Obs.—M. brevis of Woodward's Manual of the Mollusca, plate 23, figure 12, is not the above species, but, as has been pointed out by E. A. Smith, it may represent M. striata, Quoy and Gaimard. M. brevis of Messrs. H. and A. Adams' Genera, plate 98, figure 2, 2*a*, is also distinct from the above species.

Myodora pandoriformis, Stutchbury.

1835. Anatina pandoriformis, Stutchbury. Zoo. Jour., vol. v., p. 99, Tab., Sup., 43, f. 3, 4.

1844. Myadora pandoraeformis, Reeve. P.Z.S. Lond., p. 93.

1844. Myadora pandoraeformis, Reeve. Conch. Icon., vol. ii., pl. 1, f. 10.

1856. Myodora pandoriformis, Hanley. Cat. Rec. Biv. Shells, pl. 10, f. 9.

1858. Myodora brevis, H. and A. Adams (non Sowerby). Gen. Rec. Moll., vol. iii., pl. 98, f. 2, 2*a*.

1880. Myodora pandoriformis, E. A. Smith. P.Z.S. Lond., p. 581.

1885. Myodora pandoriformis, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 64.

Hab.—Port Phillip (Brit. Mus.).

MYODORA OVATA, Reeve.

1844. Myodora ovata, Reeve. P.Z.S. Lond., p. 92.

1844. Myodora ovata, Reeve. Conch. Icon., vol. ii., pl. 1, f. 4.

1862. Myodora ovata, Chenu. Man. de Conch., vol. ii., p. 52, f. 216.

1880. Myodora ovata, E. A. Smith. P.Z.S. Lond., p. 582, pl. 53, f. 2, *2a*.

Hab.—Dredged alive from 5 to 8 fathoms off Rhyll, Western Port, also San Remo and Port Phillip.

Genus Myochama, Stutchbury, 1830.

MYOCHAMA ANOMIOIDES, Stutchbury.

1835. Myochama anomioides, Stutchbury. Zoo. Jour., vol. v., p. 97, Tab., Sup., 42, f. 1-4.

1850. Myochama anomioides, A. Adams. P.Z.S. Lond., p. 23.

1853. Myochama anomioides, Hancock. A.M.N.H., vol. xi., p. 287, pl. 11 (animal).

1860. Myochama anomioides, Reeve. Conch. Icon., vol. xii., pl. 1, f. *4c* only.

1862. Myochama anomioides, Chenu. Man. de Conch., vol. ii., p. 52, f. 219.

1875. Myochama anomioides, Woodward. Man. Moll., p. 499, pl. 23, f. 13.

1884. Myochama anomioides, Tryon. Struct. and Syst. Conch., vol. iii., p. 144, pl. 108, f. 51-53.

1885. Myochama anomioides, E. A. Smith. Chall. Zool., vol. xiii.. Lam., p. 63.

1887. Myochama anomioides, Fischer. Man. de Conch., p. 1159, pl. 23, f. 13.

Hab.— Off East Moncoeur Island, Bass Straits (Challenger), generally off the Gippsland coast and frequently adherent to our large Crassatella kingicola, also on species of Glycimeris (Pectunculus).

Obs.—In the Zoological Journal, vol. v., there are six figures of this species given on plate 42, but the figures are not numbered, while in the text reference is made to figures 1, 2, 3, 4.

MYOCHAMA KEPPELLIANA, A. Adams.

1852. Myochama keppelliana, A. Adams. P.Z.S. Lond., p. 90, pl. 15, f. 1.

1860. Myochama keppelliana, Reeve. Conch. Icon., vol. xii., pl. 1, f. 2.

1884. Myochama keppelliana, Tryon. Struct. and Syst. Conch., vol. iii., p. 144, pl. 108, f. 54.

Hab.—Off Lakes' Entrance, Gippsland.

Obs.—This form appears to show sufficiently distinct characters in our examples to permit of it being retained as a good species.

Genus Thracia, Blainville, 1824.

THRACIA MYODOROIDES, E. A. Smith.

1885. Thracia myodoroides, E. A. Smith. Chall. Zool., vol. xiii., Lam., pp. 14, 70, pl. 6, f. 6-6*b*.

Hab.—Off East Moncoeur Island, Bass Straits (Challenger).

THRACIA MODESTA, Angas.

1867. Thracia modesta, Angas. P.Z.S. Lond., p. 908, pl. 44, f. 3.

1885. Thracia modesta, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 71.

Hab.—Dredged off Rhyll, Western Port; Frankston, Port Phillip.

Note.—We have two other species of the genus Thracia, one from Portsea, and the other from Hobson's Bay. Hitherto we have been unable to identify either of them.

Genus Phragmorisma, Tate.

PHRAGMORISMA WATSONI, E. A. Smith.

1885. Thracia watsoni, E. A. Smith. Chall. Zool., vol. xiii., Lam., pp. 14, 69, pl. 6, f. 5-5*b*.

1894. Phragmorisma watsoni, Tate. Jour. Roy. Soc. N.S.W., vol. xxvii., pp. 189, 190.

Hab.—Off East Moncoeur Island, Bass Straits (Challenger).

Genus **Anatina**, Lamarck, 1809.

ANATINA CRECCINA, Reeve.

1860. Anatina creccina, Reeve. Conch. Icon., vol. xiv., pl. 2, f. 12.

1865. Anatina creccina, Angas. P.Z.S. Lond., p. 644, No. 7.

Hab.—Portarlington, Hobson's Bay, Port Phillip.

ANATINA TASMANICA, Reeve.

1860. Anatina tasmanica, Reeve. Conch. Icon., vol. xiv., pl. 3, f. 20.

1860. Anatina recta, Reeve. *Id.*, pl. 4, f. 24.

Hab.—Sandringham, and Port Phillip generally.

Genus **Cochlodesma**, Couthouy, 1839.

COCHLODESMA ANGASI, Crosse and Fischer.

1864. Periploma angasi, Crosse and Fischer. Jour. d. Conch., p. 349.

1865. Periploma angasi, Crosse and Fischer. *Id.*, p. 427, pl. 11, f. 1.

1865. Anatina angasi, Angas. P.Z.S. Lond., p. 644, No. 6.

1901. Cochlodesma angasi, Suter. Trans. N.Z. Inst., vol. xxxiv, p. 220.

1902. Cochlodesma angasi, Hedley. P.L.S. N.S.W., vol. xxvii., pt. 1, p. 17.

Hab.—Frankston, Portarlington, Port Phillip.

Family MACTRIDAE.

Genus **Mactra**, Linnaeus, 1767.

MACTRA PURA Deshayes.

1839. Mactra australis, Sowerby (non Lamarck). Beechey's Zool., p. 154, pl. 44, f. 6.

1842. Mactra australis, Hanley (non Lamarck). Cat. Rec. Biv. Shells, p. 32.

1853. Mactra pura, Deshayes. P.Z.S. Lond., p. 15, No. 4.

1854. Mactra pura, Reeve. Conch. Icon., vol. viii., pl. 12, f. 53.

1856. Mactra australis, Hanley (non Lamarck). *Id.*, p. 340, pl. 10, f. 36.

1884. Mactra pura, Weinkauff. Conch. Cab., Mactra, p. 26, No. 21, pl. 9, f. 1, 1*a*, and pl. 28, f. 3.

Hab.—Western Port, San Remo, Portland (Maplestone).

Obs.—Mr. C. Hedley in the Proceedings of the Linnean Society of New South Wales, vol. xxvii., pt. 4, pp. 597-599, April, 1903, states that the identification of the South Australian bivalve, by Professor R. Tate, as Mactra pura, Deshayes, is erroneous (Tate, T.R.S. S.A., vol. ix., p. 83). The Mactra pura of which Mr. Hedley gathered an example on the beach at Green Island, off Cairns, Queensland, is stated to be a larger and flatter species with a smooth dorsal area. Mr. Hedley has had South Australian specimens compared with the type of M. abbreviata, Lamarck, but identification with that species seems unsatisfactory, even his correspondent preferring to regard our shell as a distinct species. Mr. Hedley's conclusion to call the shell M. abbreviata var., appears rather unfortunate, especially as the figures given on plate 29, figures 1-3, do not appear to illustrate the Victorian representatives of what is usually referred to here as M. pura, Deshayes.

MACTRA RUFESCENS, Lamarck.

1818. Mactra rufescens, Lamarck. Anim. S. Vert., vol. v., p. 476, No. 15.

1819. Mactra rufescens, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 105. No. 15.

1839. Mactra rufescens, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 536, No. 15.

1842. Mactra rufescens, Hanley. Cat. Rec. Biv. Shells, p. 30.

1854. Mactra rufescens, Reeve. Conch. Icon., vol. viii., pl. 3, f. 9.

1856. Mactra rufescens, Hanley. *Id.*, p. 340, pl. 10, f. 30 in text, f. 20 on plate.

1884. Mactra rufescens, Weinkauff. Conch. Cab., Mactra, pp. 88, 89, No. 93, pl. 30, f. 4, 5.

Hab.—Lakes Entrance, Gippsland, Snake Island, Port Albert; Cape Bridgewater, Portland, Apollo Bay.

MACTRA POLITA, Chemnitz.

1782. Mactra polita, Chemnitz. Conch. Cab., vol. vi., p. 222, pl. 22, f. 216, 217.

1854. Mactra polita, Reeve. Conch. Icon., vol. viii., pl. 10, f. 39.

1884. Mactra polita, Weinkauff. Conch. Cab., Mactra, pp. 14, 15, pl. 4, f. 5, 6.

Hab.—Gellibrand Coast, Cape Bridgewater, Portland.

MACTRA JACKSONENSIS, E. A. Smith.

1867. Trigonella pusilla, Angas (non A. Adams). P.Z.S. Lond., p. 916.

1885. Mactra jacksonensis, E. A. Smith. Chall. Zool., vol. xiii., Lam. p. 63, pl. 5, f. 9-9*b*.

1890. Mactra jacksoniensis, Whitelegge. Jour. Roy. Soc. N.S.W., vol. xxiii., p. 236 (p. 74 in list.).

Hab.—Dredged off Rhyll, Western Port; dredged off Portsea, 4 to 5 fathoms.

MACTRA PUSILLA, A. Adams.

1855. Mactra pusilla, A. Adams. P.Z.S. Lond., p. 226.

1885. Mactra pusilla, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 60, pl. 5, f. 8-8*c*.

Hab.—Port Albert (T. Worcester).

MACTRA OVALINA, Lamarck.

1818. Mactra ovalina, Lamarck. Anim. S. Vert. vol. v., p. 477.

1819. Mactra ovalina, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 104, No. 21.

1839. Mactra ovalina, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 537, No. 21.

1841. Mactra ovalina, Delessert. Recueil de Coq., pl. 3, f. 7*a*, *b*.

1842. Mactra ovalina, Hanley. Cat. Rec. Biv. Shells, p. 31, pl. 11, f. 23.

1854. Mactra depressa, Reeve. Conch Icon., vol. viii., pl. 14, f. 67.

1884. Mactra ovalina, Weinkauff. Conch. Cab., Mactra, pp. 69, 70, No. 70, pl. 25, f. 1, 1*a*.

1885. Mactra (Mactrinula) depressa, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 57.

1897. Hemimactra ovalina, Tate. T.R.S. S.A., vol. xxi., pt. 1, p. 46.

1901. Mactra (Mactrella) ovalina, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 423.

Hab.—Hobson's Bay and Port Phillip; Western Port.

Obs.—Our shell agrees with Lamarck's description, but not so satisfactorily with Delessert's figure. Tate says that Mactra depressa, Reeve, is admitted as a synonym of M. ovalina by the British Museum. Reeve's figure is distinctly our shell, but his name could not possibly stand even if the shell were distinct from M. ovalina as M. depressa was preoccupied by Lamarck.

Note.—We have, in addition to the above 6 species, one other unidentified form, which appears so far as present investigations have gone to represent a new species.

Genus **Spisula**, Gray, 1838.

SPISULA PARVA, Petit.

1853. Gnathodon parvum, Petit. Jour. de Conch., vol. iv., p. 358, pl. 13, f. 9, 10.

1854. Mactra rostrata, Reeve (non Spengler, Philippi, etc.). Conch. Icon., vol. viii., pl. 19, f. 104.

1854. Mactra corbuloides, Deshayes. P.Z.S. Lond., p. 63.

1854. Mactra corbuloides, Reeve. Conch. Icon., vol. viii., pl. 19, f. 103.

1867. Spisula cretacea, Angas. P.Z.S. Lond., p. 909, pl. 44, f. 6.

1867. Spisula producta, Angas. *Id.*, pl. 44, f. 7.

1871. Mactra fluviatilis, Angas. *Id.*, p. 20, pl. 1, f. 31.

1873. Gnathodon parvus, Sowerby. In Reeve Conch. Icon., vol. xix., pl. 1, f. 6.

1890. Mactra cretacea, Whitelegge. Jour. Roy. Soc. N.S.W., vol. xxiii., p. 236, No. 40 (p. 74 in list).

1891. Hemimactra cretacea, Tate. T.R.S. S.A., vol. xiv., p. 266.

1901. Spisula cretacea, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 424.

1902. Spisula parva, Hedley. *Id.*, pt. 4, pp. 707, 708, pl. 34, f. 2, 3,

Hab.—A common estuarine shell all along the coast in the sands and sandy muds of our river and creek mouths.

Obs.—This shell used to be a rarity in the neighbourhood from Port Melbourne to the Yarra mouth ; in January, 1899, only two small specimens were obtained living after a careful search, but at the present time it occurs there in the greatest abundance and frequently of considerable dimensions.

Genus **Lutraria**, Lamarck, 1799.

LUTRARIA RHYNCHAENA, Reeve.

1854. Lutraria rhynchaena, Reeve. Conch. Icon., vol. viii., pl. 4, f. 16.

1891. Lutraria oblonga, Tate (non Gmelin). T.R.S. S.A., vol. xiv., p. 266.

1897. Lutraria oblonga, Tate (non Gmelin). *Id.*, vol. xxi., pt. 1, p. 46.

1901. Lutraria rhynchaena, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 424.

Hab.—Western Port, San Remo.

Obs.—This shell has been confused with a European species which is already extremely rich in synomyns, and its inclusion therewith gives rise to considerable difficulties as well as being an extremely doubtful proceeding. There is no doubt about our shell being identical with Reeve's species, and that name should therefore stand.

Genus **Zenatia**, Gray, 1849.

ZENATIA VICTORIAE, Pritchard and Gatliff.

1903. Zenatia victoriae, Pritchard and Gatliff. P.R.S. Vic., n.s., vol. xvi., pt. 1, p. 92, pl. 15, f. 3.

Hab.—Port Albert (Mr. T. Worcester).

Obs.—The type is in Mr. Gatliff's private collection. This species differs from Zenatia acinaces, Quoy and Gaimard, by its

umbos being situated further back from the anterior, and its consequent larger development of the anterior portion of the shell; it also differs in the position and characters of the cartilage plate, and transverse ossicle, and in its proportional height being less.

Family MESODESMATIDAE.

Genus **Mesodesma**, Deshayes, 1830.

MESODESMA ERYCINAEA, Lamarck.

1819. Crassatella erycinaea, Lamarck. Anim. S. Vert., vol. vi., p. 134, No. 9.

1835. Mesodesma erycina, Quoy and Gaimard. Astrolabe Zool., vol. iii., p. 507, pl. 82, f. 1, 2, 3, 4.

1835. Mesodesma diemenense, Quoy and Gaimard. *Id.*, p. 507, pl. 82, f. 12-14.

1839. Crassatella erycinaea, Lamarck. Anim. S. Vert. (3rd. ed. Deshayes and Edwards), vol. ii., p. 539, No. 9.

1841. Crassatella erycina, Delessert. Recueil de Coq., pl. 4, f. 4*a*, *b*, *c*.

1842. Mesodesma erycina, Hanley. Cat. Rec. Biv. Shells, p. 38.

1854. Mesodesma erycinaea, Reeve. Conch. Icon., vol. viii., pl. 2, f. 12.

1856. Mesodesma erycinaeum, Hanley. Cat. Rec. Biv. Shells, p. 341, pl. 12, f. 26, and in explanation of plate M. erycinea.

Hab.—Port Albert. Alive in sand bank, Mentone, Port Phillip (J. Atkinson).

MESODESMA ELONGATA, Deshayes.

1854. Mesodesma elongata, Deshayes. P.Z.S. Lond., p. 337, No. 94.

1854. Mesodesma elongata, Reeve. Conch. Icon., vol. viii., pl. 1, f. 5.

1897. Mesodesma elongata, Tate. T.R.S. S.A., vol. xxi., pt. 1, p. 46.

Hab.—San Remo, Airey's Inlet, Apollo Bay.

Obs.—This may be distinguished from the succeeding species, M. nitida, by its more abrupt posterior truncation and more marked anterior attenuation. The type of this species is in the British Museum.

MESODESMA NITIDA, Deshayes.

1854. Mesodesma nitida, Deshayes. P.Z.S. Lond., p. 338, No. 96.

1854. Mesodesma nitida, Reeve. Conch. Icon., vol. viii., pl. 1, f. 6.

Hab.—Very common in Port Phillip.

MESODESMA GLABRELLA, Lamarck.

1819. Amphidesma glabrella, Lamarck. Anim. S. Vert. (ed. Desh.), vol. vi., p. 133.

1839. Amphidesma glabrella, Lamarck. *Id.* (3rd ed., Deshayes and Edwards), vol. ii., p. 545, No. 13.

1842. Mesodesma glabella, Hanley. Cat. Rec. Biv. Shells, p. 39.

1854. Mesodesma praecisa, Deshayes. P.Z.S. Lond., p. 338, No. 97.

1854. Mesodesma praecisa, Reeve. Conch. Icon., vol. viii., pl. 4, f. 31.

1854. Mesodesma mitis, Reeve. *Id.*, f. 29.

1856. Mesodesma glabellum, Hanley. Cat. Rec. Biv. Shells, p. 341, pl. 11, f. 6.

1864. Mesodesma obtusa, Crosse and Fischer. Jour. de Conch., vol. xii., p. 350.

1865. Mesodesma obtusa, Crosse and Fischer. *Id.*, p. 428, pl. 11, f. 4.

1865. Mesodesma praecisum, Angas. P.Z.S. Lond., p. 647.

1897. Mesodesma glabrella, Tate. T.R.S. S.A., vol. xxi., pt. 1, p. 46.

1901. Mesodesma glabrella, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 424.

Hab.—San Remo, Balnarring, Western Port.

Genus **Anapella**, Dall, 1895.

ANAPELLA CUNEATA, Lamarck.

1819. Crassatella cuneata, Lamarck. Anim. S. Vert., ed. Desh., vol. vi., p. 133.

1839. Crassatella cuneata, Lamarck. *Id.* (3rd ed., Deshayes and Edwards), vol. ii., p. 539, No. 8.

1842. Mesodesma cuneata, Hanley. Cat. Rec. Biv. Shells, p. 38.

1843. Mesodesma triquetra, Hanley. P.Z.S. Lond., p. 101.

1854. Mesodesma cuneata, Reeve. Conch. Icon., vol. viii., pl. 2, f. 9.

1854. Mesodesma triquetra, Reeve. *Id.*, pl. 4, f. 28. Mesodesma smithii, Gray.

1856. Mesodesma triquetrum, Hanley. Cat. Rec. Biv. Shells, p. 341, pl. 12, f. 20.

1875. Mesodesma (Anapa) smithii, Woodward. Man. Moll., p. 485, pl. 21, f. 17.

1876. Anapa tasmanica, T. Woods. P.R.S. Tas., p. 160.

1878. Anapa tasmanica, T. Woods. *Id.*, p. 49.

1887. Mesodesma (Anapa) smithi, Fischer. Man. d. Conch., p. 1113, pl. 21, f. 17.

1897. Anapella cuneata, Tate. T.R.S. S.A., vol. xxi., pt. 1, p. 46.

1901. Anapella cuneata, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 424.

Hab.—Coast generally, particularly estuarine localities, Port Fairy to Port Albert.

Obs.—Hanley and other authors give Mesodesma subtriangulata, Gray, as a synonym of this species, but the figure given of Mactra subtriangulata, by Wood, Index Testaceologicus, Supplement, pl. 1, f. 10, and referred to by Hanley as Gray's species, is not our shell. Tate again quotes Crassatella cycladea, Lamarck, as another synonym based on his examination of the Lamarckian type, and he also suggests that Mulinia pinguis, Crosse and Fischer, is only the triquetra form of the above species.

Family SEMELIDAE.

Genus **Semele**, Schumacher, 1817.

SEMELE EXIGUA, A. Adams.

1861. Semele exigua, A. Adams. P.Z.S. Lond., p. 385.
1865. Semele exigua, Angas. *Id.*, p. 647, No. 28.
1887. Semele exigua, Tate. T.R.S. S.A., vol. ix., p. 85, pl. 5, f. 5.

Hab.—Cowes, Phillip Island (T. S. Hall).

Family TELLINIDAE.

Genus **Gari**, Schumacher, 1817.

GARI ZONALIS, Lamarck.

1818. Psammotaea zonalis, Lamarck. Anim. S. Vert., vol. v., p. 517, No. 2.
1819. Psammotaea zonalis, Lamarck. *Id.* (ed. Desh.) vol. vi., p. 182, No. 2.
1839. Psammotaea zonalis, Lamarck. *Id.* (3rd. ed. Deshayes and Edwards), vol. ii., p. 561, No. 2.
1841. Psammotea zonalis, Delessert. Recueil de Coq., No. 2, pl. 5, f. 9*a*, *b*, *c*.
1842. Psammotaea zonalis, Hanley. Cat. Rec. Biv. Shells, p. 60.
1854. Psammobia puella, Deshayes. P.Z.S. Lond., p. 320.
1854. Psammobia striata, Deshayes. *Id.*, p. 321.
1854. Psammobia compta, Deshayes. *Id.*, p. 321.
1856. Psammobia zonalis, Reeve. Conch. Icon., vol. x., pl. 5, f. 29.
1856. Psammobia puella, Reeve. *Id.*, f. 2.
1856. Psammobia compta, Reeve. *Id.*, f. 24.
1856. Psammobia zonalis, Hanley. Cat. Rec. Biv. Shells, p. 346, pl. 11, f. 50, wrongly quoted as f. 52 in his plate reference.
1878. Gari zonalis, T. Woods. P.R.S. Tas., p. 49.
1878. Gari striata, T. Woods. *Id.*, p. 49.
1878. Gari compta, T. Woods. *Id.*, p. 49.
1885. Psammobia zonalis, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 94.

1901. Gari zonalis, Tate and May. P.L.S. N.S.W., vol. xxvi., pt, 3, p. 425.

Hab.—Hobson's Bay, Frankston, Portsea, Western Port.

Obs.—Mr. E. A. Smith, in the Challenger Report, also includes in the synonomy of the above, P. tellinaeformis, Deshayes, and P. radiata, Dunker.

Genus **Soletellina**, Blainville, 1824.

SOLETELLINA BIRADIATA, Wood.

1815. Solen biradiata, Wood. General Conch., p. 135, pl. 33, f. 1.

1825. Solen biradiata, Wood. Index Test., p. 15, No. 26, pl. 3, f. 26.

1828. Solen lividus, Wood. *Id.*, Supplement, p. 3, pl. 1, f. 3.

1828. Sanguinolaria livida, Wood. *Id.*, Supplement, p. 52.

1857. Soletellina nymphalis, Reeve. Conch. Icon., vol. x., pl. 1, f. 2.

1857. Soletellina epidermia, Reeve. *Id.*, f. 3.

1857. Soletellina biradiata, Reeve. *Id.*, pl. 2, f. 7.

1865. Hiatula biradiata, Angas. P.Z.S. Lond., p. 646, No. 19.

1878. Hiatula epidermia, T. Woods. P.R.S. Tas., p. 50.

1890. Hiatula biradiata, Whitelegge. Jour. Roy. Soc. N.S.W., vol. xxiii., p. 237, No. 60 (p. 75 in list).

1901. Solenotellina biradiata, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 425.

Hab.—Common in Port Phillip; Western Port; Portland (Maplestone).

Obs.—The copy of Wood's General Conchology in the Public Library, Melbourne, is distinctly dated 1835 on the title page, but at the end of the advertisement on the succeeding pages it is dated April, 1814. This is evidently a reprint, for volume I., which was all published, appeared in 1815, according to the British Museum Catalogue.

SOLETELLINA DONACOIDES, Reeve.

1857. Soletellina donacoides, Reeve. Conch. Icon., vol. x., pl. 3, f. 11.

Hab.—Port Melbourne, St. Kilda, Sandringham, Frankston, Port Phillip; Portland (Maplestone).

Obs.—The type of this species is from South Australia, where the shell is somewhat more inflated than our usual form.

Genus **Tellina**, Linnaeus, 1758.

TELLINA DELTOIDALIS, Lamarck.

1818. Tellina deltoidalis, Lamarck. Anim. S. Vert., vol. v., p. 532.

1819. Tellina deltoidalis, Lamarck. *Id.*, ed. Desh., vol. vi., p. 206.

1839. Tellina deltoidalis, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 569, No. 49.

1841. Tellina deltoidalis, Delessert. Recueil de Coq., No. 49, pl. 6, f. 7*a*, *b*.

1842. Tellina deltoidalis, Hanley. Cat. Rec. Biv. Shells, p. 70.

1856. Tellina deltoidalis, Hanley. *Id.*, p. 347, pl. 13, f. 3.

1865. Tellinella deltoidalis, Angas. P.Z.S. Lond., p. 646, No. 23.

1866. Tellina deltoidalis, Reeve. Conch. Icon., vol. xvii., pl. 7, f. 29*a*, *b*.

1880. Tellina deltoidalis, Hutton. Man. N.Z. Moll., p. 143.

1901. Tellina (Tellinella) deltoidalis, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 425.

Hab.—Common in Port Phillip and Western Port.

Obs.—Deshayes gives T. lactaea, Quoy and Gaimard, as a synonym of this species. Tellina australis, Deshayes, as described and figured by Reeve, Conch. Icon., vol. xvii., pl. 50, f. 297, from East Australia, appears to us to bear a strong resemblance to the above species.

TELLINA DIEMENENSIS, Deshayes.

1854. Tellina diemenensis, Deshayes. P.Z.S. Lond., p. 361.

1869. Tellina diemenensis, Reeve. Conch. Icon., vol. xvii., pl. 56, f. 333.

1901. Tellina (Tellinella) diemenensis, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 425.

Hab.—Portarlington, Point Henry, Geelong.

Obs.—This form may be only an extreme variation of T. deltoidalis, but may usually be separated from it by its smaller size, trigonal shape, and porcellaneous character.

TELLINA ALBINELLA, Lamarck.

1818. Tellina albinella, Lamarck. Anim. S. Vert., vol. v., p. 524.

1819. Tellina albinella, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 194.

1839. Tellina albinella, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 565, No. 17.

1842. Tellina albinella, Hanley. Cat. Rec. Biv. Shells, p. 63.

1856. Tellina albinella, Hanley. *Id.*, p. 347, pl. 14, f. 3.

1865. Peronacoderma albinella, Angas. P.Z.S. Lond., p. 646, No. 24.

1866. Tellina albinella, Reeve. Conch. Icon., vol. xvii., pl. 4, f. 15.

1867. Tellina albinella, Reeve (var. rosea). *Id.*, pl. 21, f. 15*b*.

1901. Tellina (Peronaea) albinella, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 426.

Hab.—Port Albert; Portland (Maplestone); Sorrento.

TELLINA TENUILIRATA, Sowerby.

1867. Tellina tenuilirata, Sowerby, in Reeve. Conch. Icon., vol. xvii., pl. 39, f. 219*a*, *b*.

1867. Tellina tenuilirata, Angas. P.Z.S. Lond., p. 919.

1885. Tellina tenuilirata, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 106.

1890. Tellina tenuilirata, Whitelegge. Jour. Roy. Soc. N.S.W., vol. xxiii., p. 238, No. 67 (p. 76 in list).

Hab.—Frankston, Port Phillip.

TELLINA ENSIFORMIS, Sowerby.

1868. Tellina ensiformis, Sowerby, in Reeve. Conch. Icon., vol. xvii., pl. 49, f. 289.

Hab.—San Remo (Mrs. Kenyon).

TELLINA RUDOLPHII, Brazier.

1898. Tellina (Strigilla) rudolphii, Brazier. P.L.S. N.S.W., vol. xxiii., pt. 2, p. 272.

Hab.—San Remo (Mrs. Kenyon).

Obs.—We have not yet met with either this or the foregoing species from our shores, but the specimens in Mrs. Kenyon's possession are undoubtedly good species.

TELLINA DECUSSATA, Wood.

1815. Tellina decussata, Wood. General Conch., p. 190, pl. 43, f. 2, 3.

1818. Tellina decussata, Lamarck. Anim. S. Vert., vol. v., p. 532.

1819. Tellina decussata, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 205.

1825. Tellina decussata, Wood. Index Test., p. 22, pl. 4, f. 81 (bad figure, might be ours).

1839. Tellina decussata, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 568, No. 45.

1842. Tellina decussata, Hanley. Cat. Rec. Biv. Shells, p. 70.

1846. Tellina decussata, Sowerby. Thes. Conch., vol. i., p. 262, No. 74, pl. 60 in text, pl. 62 on plate, f. 184.

Tellina decussata, Roemer. Mon. Tellina, pl. 23, f. 1-3.

1865. Arcopagia decussata, Angas. P.Z.S. Lond., p. 647, No. 26.

1866. Tellina decussata, Reeve. Conch. Icon., vol. xvii., pl. 17, f. 88.

1878. Tellina (Arcopagia) decussata, T. Woods. P.R.S. Tas., p. 49.

1901. Tellina (Pseudoarcopagia) decussata, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 426.

Hab.—Common in Port Phillip, also Western Port, Anderson's Inlet and Kilcunda (W. H. Ferguson).

TELLINA, n. sp.

Hab.—Rye to Portsea, Port Phillip.

Obs.—This form is something of the T. albinella type, but is much more robust, more strongly convex, and sculptured.

Genus Macoma, Leach, 1819.

MACOMA MARIAE, T. Woods.

1876. Tellina mariae, T. Woods. P.R.S. Tas., p. 162.

1901. Macoma mariae, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 426.

Hab.—Port Phillip, common from Portarlington to Geelong; Western Port.

Obs.—Tate and May in dealing with this species include M. rudis, Bertin, Archives, Mus. Nat. Hist., 1878, p. 335, pl. 9, f. 2, as a synonym, and give Port Phillip as the locality of the type; we have not seen this work, and have, therefore, been unable to confirm this point.

Family DONACIDAE.

GENUS Donax, Linnaeus, 1758.

DONAX DELTOIDES, Lamarck.

1819. Donax deltoides, Lamarck. Anim. S. Vert. (ed. Desh.), vol. vi., p. 241.

1819. Donax epidermia, Lamarck. *Id.*, p. 243.

1839. Donax deltoides, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 579, No. 5.

1839. Donax epidermia, Lamarck. *Id.*, p. 580, No. 12.

1842. Donax deltoides, Hanley. Cat. Rec. Biv. Shells, p. 80.

1842. Donax epidermia, Hanley. *Id.*, p. 80.

1854. Donax deltoides, Reeve. Conch. Icon., vol. viii., pl. 1, f. 4*a*, 4*b*.

1856. Donax deltoides, Hanley. Cat. Rec. Biv. Shells, p. 349, pl. 14, f. 23.

1865. Latona epidermia, Angas. P.Z.S., Lond., p. 647, No. 27.

1866. Donax deltoides, Sowerby. Thes. Conch., vol. iii., p. 310, No. 37, pl. 283, f. 100, 101.

Hab.—C. Bridgewater; Apollo Bay; Airey's Inlet; Kilcunda and Anderson's Inlet (W. H. Ferguson); Port Albert.

DONAX CARDIOIDES, Lamarck.

1818. Donax cardioides, Lamarck. Anim. S. Vert., vol. v., p. 550, No. 21.

1835. Donax cardioides, Quoy and Gaimard. Astrolabe Zool., vol. iii., p. 495, pl. 81, f. 17-19.

1839. Donax cardioides, Lamarck. Anim. S. Vert. (3rd ed. Deshayes and Edwards), vol. ii., p. 581, No. 21.

1841. Donax cardioides, Delessert. Recueil de Coq., pl. 6, f. 14*a*, *b*, *c*, No. 21.

1842. Donax cardioides, Hanley. Cat. Rec. Biv. Shells, p. 82.

1856. Donax cardioides, Hanley. *Id.*, p. 349, pl. 13, f. 9.

Hab.—Portsea; San Remo; Shoreham; Cowes, Phillip Island (T. S. Hall); Kilcunda and Anderson's Inlet (W. H. Ferguson).

Family PETRICOLIDAE.

Genus Venerupis, Lamarck, 1818.

VENERUPIS EXOTICA, Lamarck.

1819. Venerupis exotica, Lamarck. Anim. S. Vert. (ed. Desh.), vol. vi., p. 162, No. 4.

1819. Venerupis carditoides, Lamarck. *Id.*, p. 164, No. 7.

1839. Venerupis exotica, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 556, No. 4.

1839. Venerupis carditoides, Lamarck. *Id.*, p. 556, No. 7.

1841. Venerupis carditoides, Delessert. Recueil de Coq., No. 7, pl. 5, f. 3*a*, *b*, *c*, *d*.

1842. Venerupis exotica, Hanley. Cat. Rec. Biv. Shells, p. 54.
1842. Venerupis carditoides, Hanley. *Id.*, p. 55.
1854. Venerupis exotica, Sowerby. Thes. Conch., vol. ii., p. 764, pl. 164, f. 7.
1854. Venerupis carditoides, Sowerby. *Id.*, f. 4.
1856. Venerupis exotica. Hanley. Cat. Rec. Biv. Shells, p. 346, pl. 9, f. 29.
1874. Venerupis exotica, Reeve. Conch. Icon., vol. xix., pl. 2, f. 11.
1874. Venerupis carditoides, Reeve. *Id.*, pl. 1, f. 5.
1875. Venerupis exotica, Woodward. Man. Moll., p. 476, pl. 20, f. 15.
1887. Venerupis exotica, Fischer. Man. de Conch., p. 1087, pl. 20, f. 15.

Hab.—Port Phillip and Western Port, commoner in the latter. Portland. Puebla Coast.

Obs.—Judging from the description in Lamarck, we think it is very probable that V. distans, No. 5, is only a slight variation of the above, and perhaps ought to be regarded as a synonym. We do not agree with the treatment of various authors, indicating two distinct species for these forms.

VENERUPIS CRENATA, Lamarck.

1818. Venerupis crenata, Lamarck. Anim. S. Vert., vol. v., p. 508.
1819. Venerupis crenata, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 164, No. 6.
1839. Venerupis crenata, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 556, No. 6.
1841. Venerupis crenata, Delessert. Recueil de Coq., No. 6, pl. 5, f. 2*a*, *b*, *c*.
1842. Venerupis crenata, Hanley. Cat. Rec. Biv. Shells, p. 55.
1854. Venerupis crenata, Sowerby. Thes. Conch., vol. ii., pl. 164, f. 18, 19.
1856. Venerupis crenata, Hanley. Cat. Rec. Biv. Shells, p. 346, pl. 12, f. 58.

1865. Rupellaria crenata, Angas. P.Z.S. Lond., p. 650, No. 49.

1874. Venerupis crenata, Reeve. Conch. Icon., vol. xix., pl. 1, f. 3.

Hab.—Common Corio Bay; Portarlington; Western Port.

Obs.—Our shell agrees well with Delessert's figure, but the figures given by Reeve and Hanley are not typical, and would hardly be readily recognised as our species, but the New South Wales forms agree more closely.

VENERUPIS MITIS, Deshayes.

1853. Venerupis mitis, Deshayes. P.Z.S. Lond., p. 5, No. 20.

1874. Venerupis mitis, Reeve. Conch. Icon., vol. xix., pl. 4, f. 24.

Hab.—Corio Bay.

VENERUPIS CUMINGII, Deshayes.

1853. Venerupis cumingii, Deshayes. P.Z.S. Lond., p. 4, No. 13, pl. 18, f. 3.

1865. Rupellaria cumingi, Angas. P.Z.S. Lond., p. 650, No. 50.

1874. Venerupis cumingii, Reeve. Conch. Icon., vol. xix., No. 18, pl. 3, f. 18.

Hab.—Western Port, Flinders.

VENERUPIS, sp.

Hab.—Portarlington.

Obs.—As yet an unidentified species, comparable in some respects to V. obesa, Deshayes, but apparently distinct.

Choristodon, Jonas, 1844.

CHORISTODON LAPICIDUM, Chemnitz.

Venus lapicida, Chemnitz. Hist. Conch., pl. 172, f. 1664, 1665.

Venus divergens, Chemnitz. *Id.*, f. 1666, 1667.

1819. Petricola lucinalis, Lamarck. Anim. S. Vert. (2nd ed. Desh.), vol. vi., p. 157.

1825. Venus lapicida, Wood. Index Test., p. 37, pl. 8, f. 72.

1825. Venus divergens, Wood. *Id.*, f. 73.
1832. Petricola lucinalis, Hanley. Cat. Rec. Biv. Shells, p. 52.
1832. Petricola divergens, Hanley. *Id.*, p. 52.
1832. Petricola lapicida, Hanley. *Id.*, p. 53.
1884. Choristodon divaricatum, Tryon. Struct. and Syst. Conch., vol. iii., p. 175, pl. 112, f. 95 (given as f. 94 in text).
1887. Naranio divaricata, Tate. T.R.S. S.A., vol. ix., p. 89.
1897. Choristodon lapicidum, Tate. *Id.*, vol. xxi., pt. i., p. 46.

Hab.—San Remo (Mrs. Kenyon).

Family VENERIDAE.

Genus **Chione**, Megerle, 1811.

CHIONE DISJECTA, Perry.

1811. Venus disjecta, Perry. Conch, pl. 58, f. 3.
1818. Venus lamellata, Lamarck. Anim. S. Vert., vol. v., p. 592, No. 28.
1819. Venus lamellata, Lamarck. *Id.*, vol. vi. (ed. Desh.), p. 349, No. 28.
1825. Venus lamellata, Wood. Index Test.. p, 5, pl. 2, f. 1.
1839. Venus lamellata, Lamarck. Anim. S. Vert. (3rd ed. Deshayes and Edwards), vol. ii., p. 611, No. 28.
1841. Venus lamellata, Delessert. Recueil de Coq., No. 28, pl. 10, f. 6*a*, *b*, *c*.
1842. Venus lamellata, Hanley. Cat. Rec. Biv. Shells, p. 119.
1853. Venus lamellata, Sowerby. Thes. Conch., vol. ii., p. 725, pl. 160, f. 175.
1863. Venus lamellata, Reeve. Conch. Icon., vol. xiv., pl. 18, f. 78.
1865. Chione (Circomphalus) lamellata, Angas. P.Z.S. Lond., p. 648. No. 35.

1869. Venus lamellata, Pfeiffer. Conch. Cab., vol. xi., p. 205, No. 61, pl. 33, f. 5, 6, 10, 11, 12.

1878. Venus (Chione) lamellata, T. Woods. P.R.S. Tas., p. 51.

1902. Chione disjecta, Gatliff. V.N., vol. xix., p. 76.

Hab.—Port Phillip; Western Port; Portland (Maplestone).

Obs.—We regret that it has been found necessary to change the well-known name of this species, the older name having been re-discovered by Mr. Gatliff, and almost at the same time by Mr. Hedley, the latter's publication being the first to appear.

CHIONE FUMIGATA, Sowerby.

1853. Tapes fumigata, Sowerby. Thes. Conch., vol. ii., p. 737, No. 102, pl. 159, f. 152-155.

1853. Venus laevigata, Sowerby. *Id.*, vol. ii., p. 738, No. 103, pl. 159, f. 156-158.

1864. Tapes faba, Reeve. Conch. Icon., vol. xiv., pl. 8, f. 39.

1878. Venus (Chione) laevigata, T. Woods. P.R.S. Tas., p. 51.

1878. Venus (Chione) fumigata, T. Woods. *Id.*, p. 51.

1878. Chione (Marcia) laevigata, Angas. P.Z.S. Lond., p. 870.

1900. Chione fumigata (var. laevigata) Lodder. P.R.S. Tas., p. 17 (in reprint), No. 634.

1901. Chione laevigata, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 427.

Hab.—Common in Port Phillip; Portland (Maplestone).

CHIONE GALLINULA, Lamarck.

1818. Venus gallinula, Lamarck. Anim. S. Vert., vol. v., p. 592, No. 25.

1819. Venus gallinula, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 348, No. 25.

1828. Venus costulata, Wood. Index Test. Sup., p. 5, pl. 2, f. 15.

1839. Venus gallinula, Lamarck. Anim. S. Vert. (3rd ed. Deshayes and Edwards), vol. ii., p. 611, No. 25.

1841. Venus gallinula, Delessert. Recueil de Coq., No. 25, pl. 10, f. 1*a*, *b*, *c*.
1842. Venus gallinula, Hanley. Cat. Rec. Biv. Shells, p. 119.
1853. Venus gallinula, Sowerby. Thes. Conch., vol. ii., p. 730, No. 79, pl. 162, f. 225, 226.
1863. Venus gallinula, Reeve. Conch. Icon., vol. xiv., pl. 22, f. 106.
1864. Venus tasmanica, Reeve. *Id.*, pl. 24, f. 121.
1878. Venus (Chione) gallinula, T. Woods. P.R S. Tas., p. 51.
1897. Chione gallinula, Tate. T.R.S. S.A. vol. xxi., pt. 1, p. 47.
1902. Chione gallinula, Hedley. Mem. Austr. Mus., vol. iv., pt. 5, p. 323.

Hab.—Portsea, Port Phillip; Anderson's Inlet (W. H. Ferguson).

Obs.—We think that Mr. Hedley is probably correct in including V. coelata, Menke, as a synonym of this species, though Menke appears to have only had a young specimen.

Hanley indicates that on the authority of Deshayes, V. lagopus, Lamarck, and V. gallinula, Lamarck, are identical, and the habitat of each is given as New Holland. The former of these two species is numbered 23 in Lamarck and the latter 25, but as the description of V. lagopus is more exactly that of V. australis, Sowerby, we think that an examination of the types will show that it is the same as Sowerby's species. We do not agree with Tate and May in including V. tasmanica, Reeve, as a synonym of V. australis, Sowerby, but include it as above.

Chione lagopus, Lamarck.

1818. Venus lagopus, Lamarck. Anim. S. Vert., vol. v., p. 591, No. 23.
1819. Venus lagopus, Lamarck. *Id.* (ed. Desh.). vol. vi., p. 347, No. 23.
1835. Venus australis, Sowerby (non Gmelin). P.Z.S. Lond., p. 22.
1839. Venus lagopus, Lamarck. Anim. S. Vert. (3rd ed. Deshayes and Edwards), vol. ii., p. 610, No. 23.

1842. Venus australis, Hanley. Cat. Rec. Biv. Shells, p. 118.
1842. Venus lagopus, Hanley. *Id.*, p. 115.
1843. Venus lagopus, Menke. Moll. Nov. Holl., p. 43, No. 249.
1853. Venus australis, Sowerby. Thes. Conch., vol. ii., p. 719, No. 48.
1856. Venus australis, Hanley. Cat. Rec. Biv. Shells, p. 358, pl. 15, f. 48.
1863. Venus australis, Reeve. Conch. Icon., vol xiv., pl. 22, f. 107*a*, *b*.
1865. Chione (Timoclea) australis, Angas. P.Z.S. Lond., p. 648, No. 38.
1869. Venus australis, Pfeiffer. Conch. Cab., vol. xi., p. 219, No. 73, pl. 36, f. 4, 5.
1878. Venus (Chione) australis, T. Woods. P.R.S. Tas., p. 51.
1885. Venus (Leukoma) australis, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 131.
1897. Chione australis, Tate. T.R.S. S.A., vol. xxi., pt. 1, p. 47.
1901. Chione australis, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 427.
1903. Chione lagopus, Hedley. P.L.S. N.S.W., vol. xxvii., pt. 4, p. 596.

Hab.—Portsea, Port Phillip; Western Port; San Remo.

CHIONE CARDIOIDES, Lamarck.

1818. Erycina cardioides, Lamarck. Anim. S. Vert., vol. v., p. 486 (non Venus cardioides, Lamarck, p. 590).
1839. Erycina cardioides, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 541, No. 1.
1841. Erycina cardioides, Delessert. Recueil de Coq., pl. 4, f. 7*a*, *b c*.
1842. Erycina cardioides, Hanley. Cat. Rec. Biv. Shells, p. 40.
1853. Venus striatissima, Sowerby. Thes. Conch., vol. ii., p. 718, pl. 157, f. 103-105.

1864. Venus striatissima, Reeve. Conch. Icon., vol. xiv., pl. 26, f. 135.

1878. Venus (Chione) striatissima, T. Woods. P.R.S. Tas., p. 51.

1885. Venus (Chione) striatissima, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 124.

1902. Chione striatissima, Hedley. Mem. Austr. Mus., vol. iv., pt. 5, p. 323.

Hab.—St. Kilda, Sandringham, Frankston, Portsea, Port Phillip; Western Port; off East Moncoeur Island, Bass Strait (Challenger).

Obs.—Hanley, in the reference given above, states that he has seen Lamarck's own specimen, and that it does not belong to Erycina, but is "more like an aberrant Venus." The uniting of striatissima and cardioides had been decided upon by us from an examination of Delessert's work, but we think it is clear that cardioides, Lamarck, is the name which should stand for this species, and that the shell which requires a change of name is that subsequently described by Lamarck as Venus cardioides, if it should prove to be a Chione.

CHIONE STRIGOSA, Lamarck.

1818. Venus strigosa, Lamarck. Anim. S. Vert., vol. v., p. 605, No. 79.

1819. Venus strigosa, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 368.

1839. Venus strigosa, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 617, No. 79.

1853. Venus strigosa, Sowerby. Thes. Conch., vol. ii., p. 736, No. 99, pl. 162, f. 222, 223.

1863. Venus strigosa, Reeve. Conch. Icon., vol. xiv., pl. 20, f. 96*a*.

1878. Tapes victoriae, T. Woods. T.R.S. Vic., vol. xiv., p. 60.

1903. Chione strigosa, Pritchard and Gatliff. P.R.S. Vic., vol. xvi., n.s., pt. 1, p. 94, pl. 15, f. 4, 5, 6.

Hab.—Coast generally, very common.

Obs.—The type of Tapes victoriae, T. Woods, is from Hobson's Bay, and is in the National Museum, Melbourne, and is undoubtedly a form of the above.

CHIONE SCALARINA, Lamarck.

1818. Venus scalarina, Lamarck. Anim. S. Vert., vol. v., p. 599, No. 54.

1819. Venus scalarina, Lamarck. Anim. S. Vert. (ed. Desh.), vol. vi., p. 359, No. 54.

1839. Venus scalarina, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 614, No. 54.

1841. Venus scalarina, Delessert. Recueil de Coq., No. 54, pl. 10, f. 12*a*, *b*, *c*.

1842. Venus scalarina, Hanley. Cat. Rec. Biv. Shells, p. 123.

1843. Venus scalarina, Menke. Moll. Nov. Holl., p. 44, No. 254.

1853. Venus scalarina, Sowerby. Thes. Conch., vol. ii., p. 736, No. 96, pl. 162, f. 220.

1856. Venus scalarina, Hanley. Cat. Rec. Biv. Shells, p. 358, pl. 16, f. 4.

1863. Venus aphrodinoides, Reeve (non Lamarck). Conch. Icon., vol. xiv., pl. 17, f. 73.

1869. Venus scalarina, Pfeiffer. Conch. Icon., vol. xi., p. 212, pl. 34, f. 8-10.

1903. Chione scalarina, Pritchard and Gatliff. P.R.S. Vic., vol. xvi., n.s., pt. 1, p. 94, pl. 15, f. 7. 8.

Hab.—Coast generally.

CHIONE PERONII, Lamarck.

1818. Venus peronii, Lamarck. Anim. S. Vert., vol. v., p. 606, No. 81.

1819. Venus peronii, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 369, No. 81.

1839. Venus peronii, Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 617, No. 81.

1853. Venus peronii, Sowerby. Thes. Conch., vol. ii., p. 736, No. 97, pl. 162, f. 224.

1863. Venus peronii, Reeve. Conch. Icon., vol. xiv., pl. 20, f. 93.

1903. Chione peronii, Pritchard and Gatliff. P.R.S. Vic., vol. xvi., pt. 1, p. 94, pl. 15, f. 9, 10.

Hab.—Coast generally.

Obs.—Our reasons for limiting the references to the three foregoing species are fully set forth in the paper immediately preceding this part of the Catalogue.

CHIONE PLACIDA, Philippi.

1844. Venus placida, Philippi. Abbild. Besch., vol. i., p. 128, pl. 2, f. 2.

1844. Venus roborata, Hanley. P.Z.S. Lond., p. 161.

1853. Venus roborata, Sowerby. Thes. Conch., vol. ii., p. 723, No. 60, pl. 157, f. 116-118.

1856. Venus roborata, Hanley. Cat. Rec. Biv. Shells, p. 361, pl. 16, f. 25.

1863. Venus roborata, Reeve. Conch. Icon., vol. xiv., pl. 23, f. 113.

1869. Venus roborata, Pfeiffer. Conch. Cab., vol. xi., pp. 238, 239, No. 93, pl. 41, f. 3-5.

1878. Venus (Chione) roborata, T. Woods. P.R.S. Tas., p. 51.

1902. Chione placida, Hedley. Mem. Austr. Mus., vol. iv., pt. 5, p. 322.

Hab.—Portsea, Port Phillip; San Remo; Port Albert (T. Worcester).

Obs.—In the last reference, Mr. Hedley shows that, according to date of publication, priority falls to Philippi's name. Pfeiffer, in the Conchylien Cabinet, and others, give V. placida as a synonym of V. roborata, and do not appear satisfied that Philippi's name has priority.

CHIONE UNDULOSA, Lamarck.

1818. Venus undulosa, Lamarck. Anim. S. Vert., vol. v., p. 606, No. 85.

1819. Venus undulosa, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 370, No. 85.

1835. Venus variabilis, Sowerby. P.Z.S. Lond., p. 42.

1839. Venus undulosa, Lamarck. Anim. S. Vert. (3rd ed. Deshayes and Edwards), vol. ii., p. 617, No. 85.

1842. Venus undulosa, Hanley. Cat. Rec. Biv. Shells, p. 126.
1843. Venus undulosa, Philippi. Abbild. Besch., vol. i., p. 39, pl. i., f. 1.
1853. Venus undulosa Sowerby. Thes. Conch., vol. ii., p. 738, No. 107, pl. 158, f. 142-146.
1856. Venus undulosa, Hanley. Cat. Rec. Biv. Shells, p. 358, pl. 15, f. 49.
1864. Venus undulosa, Reeve. Conch. Icon., vol. xiv., pl. 24, f. 117, and pl. 25, f. 126.
1878. Tivela undulosa, Angas. P.Z.S. Lond., p. 870, No. 63.
1884. Venus (Marcia) undulosa, Tryon. Struct. and Syst. Conch., vol. iii., p. 177, pl. 113, f. 18.
1885. Venus (Gomphina) undulosa, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 132.

Hab.—Portsea, Port Phillip; San Remo; dredged alive off Balnarring, Western Port; Kilcunda and Cape Paterson to Anderson's Inlet (W. H. Ferguson); Airey's Inlet; Apollo Bay to Blanket Bay.

Genus Meretrix, Lamarck, 1799.

MERETRIX DISRUPTA, Sowerby.

1853. Cytherea disrupta, Sowerby. Thes. Conch., vol. ii., p. 743, pl. 163, f. 208, 209.
1885. Cytherea (Callista) disrupta, E. A. Smith. Chall. Zool., vol xiii., Lam., p. 135, pl. 1, f. 4-4*e*.

Hab.—Port Phillip Heads.

Obs.—We agree with Mr. Hedley in regarding this as distinct from M. planatella, though very closely related.

MERETRIX PLANATELLA, Lamarck.

1818. Cytherea planatella, Lamarck. Anim. S. Vert., vol. v., p. 565, No. 19.
1819. Cytherea planatella, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 305, No. 19.
1835. Venus nitida, Quoy and Gaimard. Astrolabe Zool., vol. iii., p. 529, pl. 84, f. 13, 14.

1839. Cytherea planatella, Lamarck. Anim. S. Vert. (3rd ed. Deshayes and Edwards), vol. ii., p. 599, No. 19.

1844. Cytherea diemenensis, Hanley. P.Z.S. Lond., p. 110.

1845. Cytherea planatella, Philippi. Abbild. Besch., vol. i., p. 199, pl. 3, f. 6.

1851. Cytherea planatella, Sowerby. Thes. Conch., vol. ii., p. 786.

1851. Cytherea innocens, Sowerby. *Id.*, vol. ii., p. 743, sp. 118, pl. 163, f. 210.

1869. Callista planatella, Römer. Mon. Venus, p. 65, No. 21, pl. 19, f. 2.

1878. Callista diemanensis, T. Woods. P.R.S. Tas., p. 51.

1901. Meretrix planatella, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 428.

1902. Meretrix planatella, Hedley. Mem. Austr. Mus., vol. iv., pt. 5, p. 323.

Hab.—San Remo.

Obs.—We think Venus nitida, Quoy and Gaimard, a very doubtful inclusion with the above.

MERETRIX PAUCILAMELLATA, Dunker.

1858. Mercenaria paucilamellata, Dunker. Novit. Conch., p. 52, pl. 16, f. 10-12.

1863. Cytherea alatus, Reeve. Conch. Icon., vol. xiv., pl. 18, f. 83.

1876. Callista victoriae, T. Woods. P.R.S. Tas., p. 159.

1880. Mercenaria paucilamellata, Brazier. P.L.S. N.S.W., vol. v., p. 486, No. 9.

1885. Venus (Chione) jacksoni, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 123, pl. 3, f. 2-2*e*.

1897. Meretrix alatus, Tate. T.R.S. S.A., vol. xxi., pt. 1, pp. 47, 48.

Hab.—Portland; Otway Coast; Port Albert (T. Worcester).

MERETRIX KINGII, Gray.

1827. Cytherea kingii, Gray, in King's Survey of Australia, vol. ii., p. 474.

1828. Venus kingii, Wood. Index Test., Sup. p. 5, sp. 9, pl. 2, f. 9.
1838. Cytherea lamarckii, Gray. Analyst, vol. viii., p. 308.
1842. Cytherea kingii, Hanley. Cat. Rec. Biv. Shells, p. 106.
1842. Cytherea lamarkii, Hanley. *Id.*, p. 103.
1851. Cytherea kingii, Sowerby. Thes. Conch., vol. ii., p. 638, sp. 92, pl. 133, f. 129, 130.
1851. Cytherea lamarckii, Sowerby. *Id.*, p. 785, f. 129.
1851. Cytherea rutila, Sowerby. *Id.*, p. 743, sp. 116, pl. 163, f. 205.
1853. Dione kingii, Deshayes. B. M. Cat., pt. 1, p. 69, No. 42.
1853. Dione rutila, Deshayes. *Id.*, p. 58, No. 7.
1853. Dione lamarckii, Deshayes. *Id.*, p. 69, No. 45.
1863. Dione rutila, Reeve. Conch. Icon., vol. xiv., pl. 5, f. 18.
1863. Dione kingii, Reeve. *Id.*, pl. 9, f. 36*b*.
1869. Cytherea (Callista) rutila, Römer. Mon. Venus, vol. i., p. 51, No. 6.
1869. Cytherea (Caryatis) kingii, Römer. *Id.*, p. 69, pl. 26, f. 1.
1869. Cytherea (Caryatis) lamarckii, Römer. *Id.*, p. 97, No. 20, pl. 26, f. 2 on plate.
1885. Cytherea (Callista) rutila, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 133.
1895. Cytherea kingii, Cox. Observations on a Cytherea found in Bass Straits. Printed in Sydney.
1900. Cytherea lamarckii, Hedley. P.L.S. N.S.W., vol. xxv., pt. 3, p. 498.

Hab.—Common in Port Phillip, dredged alive off Brighton, 4 to 5 fathoms; Western Port; off East Moncoeur Island, Bass Strait (Challenger).

Genus **Circe**, Schumacher, 1817.

CIRCE PYTHINOIDES, T. Woods.

1878. Circe pythinoides, T. Woods. T.R.S. Vic., vol. xiv., p. 60.

Hab.—Port Phillip Heads.

Obs.—The type of this species is in the National Museum, Melbourne, but we have not yet critically compared this with other Australian species.

Genus **Sunetta**, Link, 1807.

SUNETTA EXCAVATA, Hanley.

1842. Cytherea excavata, Hanley. P.Z.S. Lond., p. 123.

1842. Cytherea excavata, Hanley. Cat. Rec. Biv. Shells, p. 109.

1843. Cytherea vaginalis, Menke. Moll. Nov. Holl., p. 42, No. 246.

? 1847. Cytherea vaginalis, Philippi. Abbild. Besch., vol. iii., p. 96, pl. 3, f. 2.

1851. Meroe excavata, Sowerby. Thes. Conch., vol. ii., p. 610, No. 5, pl. 126, f. 13, 14.

1856. Cytherea excavata, Hanley. Cat. Rec. Biv. Shells, p. 354, pl. 15, f. 19.

1863. Sunetta aliciae, Adams and Angas. P.Z.S. Lond., p. 425, pl. 37, f. 18.

1864. Meroe vaginalis, Reeve. Conch. Icon., vol. xiv., pl. iii., f. 7.

1864. Meroe aliciae, Reeve. *Id.*, pl. 3, f. 8.

1864. Meroe excavata, Reeve. *Id.*, pl. 3, f. 11*a*, *b*.

1865. Sunetta aliciae, Angas. P.Z.S. Lond., p. 649, No. 45.

1869. Sunetta aliciae, Römer. Mon. Venus, p. 13, No. 9, pl. 4, f. 1.

1869. Sunetta excavata, Römer. *Id.*, p. 12, pl. 3, f. 3.

1881. Cuneus vaginalis, Tate. P.L.S. N.S.W., vol. vi., p. 407.

1901. Sunetta vaginalis, Tate and May. *Id.*, vol. xxvi., pt. 3, p. 429.

Hab.—Western Port; Apollo Bay to Blanket Bay (common); Lakes Entrance, Gippsland.

Genus **Dosinia**, Scopoli, 1777.

DOSINIA CROCEA, Deshayes.

1853. Dosinia crocea, Deshayes. B. M. Cat., pp. 8, 9, No. 10.

1862. Dosinia crocea, Römer. Mon. Dosinia, p. 71, pl. 13, f. 4, 4*a*, 4*b*.

Hab.—San Remo.

Obs.—Type from Flinders Island and in the British Museum.

DOSINIA VARIEGATA, Gray.

1838. Artemis variegata, Gray. Analyst, vol. viii., p. 309.

1850. Artemis variegata, Reeve. Conch. Icon., vol. vi., pl. 6, f. 33*a*, not *b* and *c*.

1852. Artemis variegata, Sowerby. Thes. Conch., vol. ii., pt. 13, p. 675, No. 72, pl. 144, f. 83.

Hab.—Port Phillip; Western Port.

DOSINIA COERULEA, Reeve.

1850. Artemis coerulaea, Reeve. Conch. Icon., vol. vi., pl. 4, f. 25.

1852. Artemis coerulaea, Sowerby. Thes. Conch., vol. ii., pt. 13, p. 664, No. 32, pl. 142, f. 43, 44.

1853. Dosinia coerulea, Deshayes. B.M. Cat., p. 19, No. 46.

1862. Dosinia coerulaea, Römer. Mon. Dosinia, p. 71, No. 86, pl. 13, f. 4, 4*a*, 4*b*.

Hab.—Port Phillip; Western Port.

DOSINIA CIRCINARIA, Deshayes.

1853. Dosinia circinaria, Deshayes. B. M. Cat., pp. 9, 10, No. 14.

1862. Dosinia circinaria, Römer. Mon. Dosinia, p. 19, No. 16.

1863. Dosinia cydippe, A. Adams. P.Z.S. Lond., p. 224.

1885. Dosinia circinaria, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 150, pl. 1, f. 2.

1890. Dosinia circinaria, Whitelegge. Jour. Roy. Soc. N.S.W., vol. xxiii., p. 240, No. 105 (p. 78 in list).

1898. Lucina (Codakia) ambigua, Brazier. P.L.S. N.S.W., vol. xxiii., pt. 2, p. 272.

1901. Dosinia cincinaria, Tate and May. *Id.*, vol. xxvi., pt. 3, p. 429.

Hab.—Rye to Portsea, Port Phillip; Western Port,

Obs.—The type of L. ambigua, Brazier, is in the possession of Mrs. Kenyon, and has been examined, so that there is no doubt about its inclusion with the above, it is simply a stunted form with irregular lines of growth.

Genus, **Tapes,** Megerle von Mühlfeldt, 1811.

TAPES FABAGELLA, Deshayes.

1853. Tapes fabagella, Deshayes. P.Z.S. Lond., p. 10, No. 45.

1853. Tapes fabagella, Deshayes. B. M. Cat., pt. 1, p. 182, No. 62.

1864. Tapes fabagella, Reeve. Conch. Icon., vol. xiv., pl. 13, f. 66.

1869. Tapes fabagella, Römer. Mon. Venus, p. 91, No. 68, pl. 31, f. 2, 2*a*, 2*b*.

1876. Rupellaria reticulata, T. Woods. P.R.S. Tas., p. 159.

1878. Tapes flabagella, Angas. P.Z.S. Lond., p. 870, No. 61.

1885. Tapes (Amygdala) fabagella, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 116.

1901. Tapes fabagella, Tate and May. P.L.S. N.S.W., vol. xxvi., pt, 3, p. 429.

Hab.—Common in Port Phillip and Western Port. Puebla Coast.

Obs.—Tate and May include in the synonomy of the above Tapes victoriae, T. Woods, the type of which is in the National Museum, Melbourne, but from our examination we have referred that shell to Chione strigosa.

TAPES GALACTITES, Lamarck.

1818. Venus galactites, Lamarck. Anim. S. Vert., vol. v., p. 599, No. 52.

1819. Venus galactites, Lamarck. *Id.* (ed. Desh.), vol. vi., p. 359, No. 52.
1827. Venerupis galactites, Gray, in King's survey of Australia, vol. ii., p. 475, No. 7.
1839. Venus galactites, Lamarck. Anim. S. Vert. (3rd ed. Deshayes and Edwards), vol. ii., p. 614, No. 52.
1842. Venus galactites, Hanley. Cat. Rec. Biv. Shells, p. 123.
1852. Tapes galactites. Sowerby. Thes. Conch., vol. ii., p. 695, pl. 151, f. 132.
1853. Tapes galactites, Deshayes. B. M. Cat., pt. 1, p. 183, No. 66.
1856. Venus galactites, Hanley. Cat. Rec. Biv. Shells, p. 358, pl. 15, f. 51.
1864. Tapes galactites, Reeve. Conch. Icon., vol. xiv., pl. 12, f. 65.
1869. Tapes galactites, Römer. Mon. Venus, p. 93, No. 72, pl. 32, f. 3.
1878. Rupellaria subdecussata, T. Woods. P.R.S. Tas., p. 52.
1901. Tapes galactites, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 429.

Hab.—Very common in Port Phillip; Western Port; Anderson's Inlet and Kilcunda (W. H. Ferguson).

Family Cardiidae.

Genus Cardium, Linnaeus, 1758.

Cardium cygnorum, Deshayes.

1854. Cardium cygnorum, Deshayes. P.Z.S. Lond., p. 331, No. 63.
1865. Cardium (Trachycardium) cygnorum, Angas. P.Z.S. Lond., p. 651, No. 53.
1878. Cardium cygnorum, T. Woods. P.R.S. Tas., p. 53.

Hab.—Old valves occasionally obtained at Carrum, Rye, Portsea, Port Phillip; dredged alive Western Port.

CARDIUM PULCHELLUM, Gray.

1840. Cardium striatulum, Sowerby (non Brocchi). P.Z.S. Lond., p. 105.

1841. Cardium striatulum, Sowerby. Conch. Ill., sp. 9, pl. 49, f. 16, and pl. 177, f. 45.

1842. Cardium striatulum, Hanley. Cat. Rec. Biv. Shells, p. 135.

1843. Cardium pulchellum, Gray. Dieffenbach's New Zealand, vol. ii., p. 252.

1844. Cardium pulchellum, Reeve. Conch. Icon., vol. ii., pl. 8, f. 42.

1844. Cardium striatulum, Reeve. *Id.*, pl. 86, f. 60.

1856. Cardium striatulum, Hanley. Cat. Rec. Biv. Shells, p. 363, pl. 17, f. 9.

1873. Cardium striatulum, Hutton. Cat. Moll. N.Z., p. 73, No. 80.

1878. Cardium pulchellum, Angas. P.Z.S. Lond., p. 870, No. 64.

1880. Cardium striatulum, Hutton. Man. N.Z. Moll., p. 153.

1885. Cardium (Bucardium) pulchellum, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 161.

1901. Cardium pulchellum, Suter. Trans. N.Z. Inst., vol. xxxiv., p. 222.

1902. Cardium striatulum, Hedley. Mem. Austr. Mus., vol. iv., pt. 5, p. 322.

Hab.—Off Port Phillip, and off East Moncoeur Island, Bass Strait (Challenger); Port Phillip Heads (J. B. Wilson); Portsea; dredged off Rhyll, Western Port, about 6 fathoms.

Obs.—We quite agree with Mr. E. A. Smith's treatment of this species. Mr. Hedley states in his above quoted paper that f. 45, in Sowerby, Conchological Illustrations, is not this shell. With this we do not agree.

CARDIUM TENUICOSTATUM, Lamarck.

1819. Cardium tenuicostatum, Lamarck. Anim. S. Vert. (ed. Desh.), vol. vi., p. 372.

1839. Cardium tenuicostatum. Lamarck. *Id.* (3rd ed. Deshayes and Edwards), vol. ii., p. 624, No. 5.

1841. Cardium tenuicostatum, Delessert. Recueil de Coq., pl. 11, f. *6a-c*.
1841. Cardium tenuicostatum, Sowerby. Conch. Ill., pl. 162, f. 36.
1842. Cardium tenuicostatum, Hanley. Cat. Rec. Biv. Shells, p. 130.
1844. Cardium tenuicostatum, Reeve. Conch. Icon., vol. ii., pl. 10, f. 50.
1856. Cardium tenuicostatum, Hanley. Cat. Rec. Biv. Shells, p. 363, pl. 17, f. 26.
1865. Papyridea tenuicostata, Angas. P.Z.S. Lond., p. 651, No. 54.
Cardium tenuicostatum, Römer. Conch. Cab., p. 69, pl. 12, f. 6, 7.
Cardium pallidum, Römer. *Id.*, f. 92.
Cardium radiatum, Römer. *Id.*, f. 89.
1878. Cardium tenuicostatum, T. Woods. P.R.S. Tas., p. 53.
1885. Cardium (Bucardium) tenuicostatum, E. A. Smith. Chall. Zool., vol. xiii., Lam., p. 159.
1890. Cardium tenuicostatum, Whitelegge. Jour. Roy. Soc. N.S.W., vol. xxiii., p. 240, No. 114 (p. 78 in reprint).
1901. Cardium tenuicostatum, Tate and May. P.L.S. N.S.W., vol. xxvi., pt. 3, p. 430.

Hab.—Coast generally. Rather common in dredgings off Point Cooke, Port Phillip, 3 to 5 fathoms, sand.

Family CHAMIDAE.

Genus **Chamostrea**, de Roissy, 1825.

CHAMOSTREA ALBIDA, Lamarck.

1819. Chama albida, Lamarck. Anim. S. Vert. (ed. Desh.), vol. vi., p. 585.
? 1822. Cleidothaerus chamoides, Sowerby. Genera, f. 1, 2, 3.
1835. Cleidothaerus chamoides, Stutchbury. Zool. Jour., vol. v., p. 98, pl. 42, bis.

1839. Cleidothaerus albidus, Deshayes. Anim. S. Vert. (3rd ed. Deshayes and Edwards), vol. ii., p. 684.

1843. Chama albida, Hanley. Cat. Rec. Biv. Shells, p. 227.

1843. Cleïdothaerus chamoides, Hanley. *Id.*, p. 227.

1856. Cleidothaerus chamoides, Hanley. *Id.*, p. 387, pl. 24, f. 20.

1863. Chamostrea albida, Reeve. Conch. Icon., vol. xiv., pl. 1, f. 1.

1875. Chamostrea albida, Woodward. Man. Moll., p. 500, pl. 23, f. 14.

1884. Chamostrea albida, Tryon. Struct. and Syst. Conch., vol. iii., p. 202, pl. 117, f. 16, 17.

1887. Chamostrea albida, Fischer. Man. de Conch., p. 1160, pl. 23, f. 14.

Hab.—Port Phillip and Western Port. Common in 3 to 6 fathoms, rocky bottom.

Family LUCINIDAE.

Genus **Lucina**, Brugière, 1792.

LUCINA MINIMA, T. Woods.

1876. Lucina minima, T. Woods. P.R.S. Tas., p. 162.

1878. Lucina (Codakia) tatei, Angas. P.Z.S. Lond., p. 863, pl. 54, f. 15.

1897. Lucina minima, Tate. T.R.S. S.A., vol. xxi., pt. 1, p. 48.

1902. Lucina minima, May. P.R.S. Tas., p. 9 (in pamphlet), f. 12.

Hab.—Coast generally.

LUCINA BRAZIERI, Sowerby.

1883. Tellina brazieri, Sowerby. P.Z.S. Lond., p. 31, pl. 7, f. 2 (non T. brazieri, Sowerby, 1869).

1902. Lucina brazieri, Hedley. Mem. Austr. Mus., vol. iv., pt. 5, p. 319.

Hab.—Port Phillip; Western Port.

LUCINA HUTTONIANA, Vanatta.

1901. Lucina (Divaricella) huttoniana, Vanatta. Proc. Acad. Nat. Sci., Philad., p. 184, pl. 5, f. 14, 15.

Hab.—Port Phillip and Western Port; Puebla Coast.

Obs.—This species has been confused with L. divaricata, Lamarck, L. dentata, Wood, L. quadrisulcata, D'Orbigny, and L. cumingi, Adams and Angas, and other species, but it is clearly distinguished and well defined by the above.

LUCINA PEROBLIQUA, Tate.

1892. Lucina perobliqua, Tate. T.R.S. S.A., vol. xv., pt. 2, p. 128, pl. 1, f. 10.

Hab.—Portsea, Port Phillip.

LUCINA PAUPERA, Tate.

1892. Lucina paupera, Tate. T.R.S. S.A., vol. xv., pt. 2, p. 129, pl. 1, f. 6.

Hab.—Ocean Beach, Point Nepean.

Genus **Loripes**, Poli, 1791.

LORIPES ASSIMILIS, Angas.

1867. Loripes assimilis, Angas. P.Z.S. Lond., p. 910, pl. 44, f. 8.

Hab.—Western Port.

LORIPES CRASSILIRATA, Tate.

1887. Lucina crassilirata, Tate. T.R.S. S.A., vol. ix., p. 67, pl. 4, f. 2.

Hab.—Western Port.

LORIPES ICTERICA, Reeve.

1850. Loripes icterica, Reeve. Conch. Icon., vol. vi., pl. 10, f. 60*a*, 60*b*.

1865. Loripes icterica, Angas. P.Z.S. Lond., p. 651, No. 59.

1867. Loripes icterica, Angas. *Id.*, p. 910.

1878. Loripes icterica, T. Woods. P.R.S. Tas., p. 53.

Hab.—Common coast generally.

LORIPES sp.

Hab.—Port Phillip and Western Port.

Obs.—This species we have been hitherto unable to satisfactorily identify.

Art. IX.—*Further Descriptions of the Tertiary Polyzoa of Victoria.—Part IX.*

By C. M. MAPLESTONE

(With Plates XVI., XVII.).

[Read 2nd July, 1903].

Dimorphocella, nov. gen.

Two distinct forms of cells. Zooecial cells elongated or rhomboidal, distinct. Thyrostome arched above, with a sinus in the lower lip. Ooecial cells much larger than the zooecial, elongate, pyriform or oval, with a broad aperture and a perforated area in front.

I propose this genus for a form presently to be described, and Adeonella triton, McG., the systematic position of which he (Dr. MacGillivray) says admits of great doubt.[1] I do not consider it belongs to the genus he places it in, if his definition of it given in his catalogue of the Marine Polyzoa of Victoria, p. 27, be accepted. Busk in the Report of the "Challenger" Polyzoa, describes Adeoneae as a new family which he divides into two genera, Adeona and Adeonella, but the characters upon which he separates them are purely zoarial, and moreover, he states, "there is no difference whatever" in the zooecial characteristics of the genera. Consequently, as zooecial characteristics are more relied upon now than zoarial, the genus Adeonella I think must lapse. Dr. MacGillivray places Adeona in Microporellidae, and Adeonella in Escharidae, sub-family Mucronellinae, in his "Catalogue," and in his Monograph of the Tertiary Polyzoa of Victoria he places Adeonella in Schizoporellidae, but does not define it. Again, in the description of Adeonella, in the "Catalogue" the following character is mentioned, "peristome developing a process from each side below, the two meeting in the middle to leave a round suboral foramen opening into the throat in front of the operculum." Now, no mention is made of such a character in the *specific* description of A. triton, it is not shown in the figures (pl. ix., figs. 23 and 23*a*), and this charac-

1 Trans. Royal Society Victoria, vol. iv., p. 90.

ter does not appear in my specimen of it, or in D. pyriformis; the front wall of the zooecial cells has no foramen, and the peristome of A. triton is simply a slightly thickened margin, and in D. pyriformis it is almost imperceptible. Therefore, the zooecial cells in both these species being without a foramen, I do not consider they can rightly be placed in Adeonella, or that they belong to the Adeoneae, though closely allied.

Dimorphocella pyriformis, n. sp. (Pl. XVI., Fig. 1).

Zooecia rhomboidal, flat; margins linear, raised; a very few small pores round the margin. Thyrostome lofty, with slightly raised peristome; a deep narrow sinus in the proximal border. An avicularium on each side below the thyrostome, with the mandibles pointing horizontally, and nearly meeting in the median line. Ooecial cells large, pyriform, ventricose distally; aperture transverse, lenticular; an avicularium on each side below it with mandibles pointing horizontally inwards; a small perforated oval raised area below the aperture; a few minute pores, chiefly marginal.

Locality.—Mitchell River (J. Dennant).

This differs from Dimorphocella (Adeonella) triton, in the following respects: both the zooecial and the ooecial cells are smaller; in the infertile zooecia the avicularia are horizontal, not vertical; the thyrostome has a deep narrow sinus instead of a very broad one; the ooecial cells are pyriform, not oval, and the distal part is ventricose; the perforated area is small, somewhat raised; the aperture much smaller and narrower, and the pores on the surface are very small and easily overlooked.

I have drawn an ooecial cell and part of a zooecial one of D. triton (Fig. 2), to show the difference between the two species, and also because the ooecial cell has a more perfect perforated area than that shown in Dr. MacGillivray's figure. The two speeies are mounted on the same slide, as under a simple lens they appeared to be the same.

Phylactella cribrosa, n. sp. (Pl. XVI., Fig. 3).

Zoarium encrusting. Zooecia irregularly oval, covered with large perforations. Thyrostome oblong; peristome much raised and rugose.

Locality.—Wilkinson's, No. 4 (Hall and Pritchard).

A small fragment only. This is near P. porosa (McG.), but the zooecia are larger and there is no space devoid of pores below the thyrostome as in that species.

Schismopora circumvallata, n. sp. (Pl. XVI., Fig. 4).

Zoarium encrusting. Zooecia oval, ventricose; surface coarsely granular. Thyrostome arched distally, proximal margin straight, with a small sinus in the centre; peristome oval, very thick and much raised.

Locality.—Spring Creek (T. S. Hall).

I am doubtful whether to place this in Schismopora or Schizoporella, but the thyrostome is placed at a considerable distance below the highly raised peristome and in this respect agrees rather with Schismopora than with Schizoporella. I have only the fragment illustrated and the two lower zooecia do not appear to be perfect, the lower portion is probably broken away.

Schismopora otwayensis, n. sp. (Pl. XVI., Fig. 5).

Zoarium small, globular. Zooecia irregularly arranged, sub-immersed, surface smooth. Thyrostome semicircular with a sinus in the proximal margin; peristome highly raised, being produced into a tubular, or subtubular elevated process on the distal margin, surmounted by an avicularium with the mandible pointing upwards; sometimes a small umbo, with a perforation, on the proximal margin. Large spatulate avicularia scattered among the zooecia. Ooecia hemispherical (kettledrum shaped), with flat vertical front wall.

Locality.—Cape Otway (Hall and Pritchard).

This resembles Cellepora granum but the thyrostome (or primary orifice) has a sinus in the proximal margin which removes it from Cellepora, and the avicularium is at the summit of the tubular process and not near the base.

Cellepora stellata, n.sp. (Pl. XVI., Fig. 6).

Zoarium discoid, raised in the centre. Zooecia oval; marginal ones produced distally, surface smooth, front somewhat flattened. Thyrostome sub-orbicular with distal margin incurved and an avicularium above.

Locality.—Orphanage Hill, Geelong (T. S. Hall), and Campbell's Point (J. F. Mulder).

The zooecia in the centre are generally imperfect, through erosion. This is near C. fossa, but differs from it in the zooecia not being so ventricose, and in having a flattened area in front. The marginal zooecia project so as to give a stellate appearance to the zoaria.

Solenopora, nov. gen.

Zooecia ovoid. Thyrostome oval, within which is a tubular process with a circular pore on the summit. Ooecium large, globular, subimmersed.

This genus is very near Cellepora, but the tubular process is inside the thyrostome, a unique condition; some of the Celleporidae have one on the outside.

Solenopora tubulifera, n. sp. (Pl. Fig. 7).

Zoarium encrusting. Zooecia ovoid or pear-shaped, subimmersed, surface smooth. Thyrostome oval, with peristome produced distally supporting inside. a tubular process (probably avicularian) with a circular pore at the summit: two raised tubular processes below the thyrostome and a few scattered pores near the base of the zooecia: spatulate avicularia scattered among the zooecia. Ooecia very large, globular, subimmersed with an irregularly elliptical aperture and a small raised disk below with an oval pore it it.

Locality.—Wilkinson's, No. 4 (Hall and Pritchard).

Retepora uniserialis, n. sp. (Pl. XVI., Fig. 8).

Zoarium dendroid (?). Zooecia in single series, oval, with narrow raised margins; surface smooth. Thyrostome arched distally, proximal margin straight, with deep narrow sinus in the centre; a spine on each side about the middle. An enormous, raised avicularium below, covering almost the whole surface of the zooecium; with sometimes two pores near the proximal end. Above the thyrostome is an oval smooth depression which is probably the base of an ooecium.

Locality.—Mitchell River (J. Dennant).

This is found in a very fragmentary state; the fragments being very long in proportion to their width, the zoaria were probably dendroid. On one, or both sides of the zooecia there is a perforation, irregularly shaped, which may have been caused by the fracture of an avicularium.

Retepora airensis, n. sp. (Pl. XVII., Fig. 9).

Zoarium reticulate (?). Zooecia about two or three abreast, elongated, irregularly hexagonal, with raised margins; surface slightly depressed and covered with concave granulations. Thyrostome suborbicular, with raised, wavy edged peristome, generally having a pointed mucro at the proximal edge. A large raised avicularium below, with slightly curved mandible pointing proximally. Dorsal surface vibicate, granulated.

Locality.—Aire Coastal Beds (Hall and Pritchard).

This, if reticulate, must have had the fenestrae very large, compared with the trabeculae, as the specimens are all in fragments and only a few show any signs of branching.

Retepora delicatula, n. sp. (Pl. XVII., Fig. 10 and 10*a*).

Zoarium dendroid (?). Zooecia in single series, elongate, oval; surface smooth. Thyrostome with raised, thin peristome with a deep sinus below. Very large, raised, vicarious avicularia with long slightly curved mandibles pointing proximally.

Locality.—Aire Coastal Beds (Hall and Pritchard).

This is a very delicate species and evidently dendroid; the avicularia are very prominent and rival the zooecia in size. The two figures given are of the same specimen tilted over laterally, the angular difference being about 45 deg.

Retepora arborescens, n. sp. (Pl. XVII., Fig. 11 and 11*a*).

Zoarium dendroid. Zooecia elongated, surface covered with large, convex granulations. Thyrostome suborbicular; peristome much raised, having a wide sinus proximally. Large, raised avicularia with long mandible pointing proximally on some portions only of zoarium. Dorsal surface vibicate, granulated.

Locality.— Mitchell River (J. Dennant).

This a very good example of a dendroid Retepora. The zoaria are generally without avicularia, but in the specimen of which a figure, natural size, is given about a third of the middle portion is covered with large, raised avicularia scattered over the surface interfering with the regularity of, and almost obscuring, the zooecia, but that part is not in good preservation so I have not figured them; on the lower and upper parts the zooecia are regularly disposed and without avicularia; the branches are not the some plane, the upper one recedes and the middle and right hand branches curve upwards.

Retepora complanata, n. sp. (Pl. XVII., Fig. 12 and 12*a*).

Zoarium reticulate, fenestrae elongated, oval. Zoecia subhexagonal, elongated, with raised margins; surface finely granulated. Thyrostome orbicular; peristome raised, with a mucro pointing inwards on the proximal margin where it expands in width and in the expansion there is a small pore, probably avicularian. Dorsal surface coarsely granulated, divided by raised vibices into very large areas.

Locality.—Mitchell River (J. Dennant).

This is characterised by the extreme simplicity of the form of the zooecia, and the very large areas on the dorsal surface.

This concludes the description of all those Cheilostomatous species that I have been able, up to the present time, to determine as new in the material, from the various Tertiary deposits, that has been kindly presented to me by Messrs. Hall, Pritchard, Dennant, Kitson and others. I have still a large number of specimens undetermined, but I have had sent to me a great many recent forms from South and North Australia, New Hebrides, and other localities which urgently demand my attention, and of which a cursory examination has shown me that many of them are new. I had intended postponing dealing with these until after I had described some new species of fossil Cyclostomata, but there is such a difference of opinion as to the proper classification of this order, and I see so much difficulty ahead in determining their position, that I will leave them for a time;

nevertheless, there is one new form which I now describe, because it is a very elegant and striking one.

Hornera airensis, n. sp. (Pl. XVII., Fig. 13 and 13*a*).

Zoarium dendroid, dichotomously branched, branches circular in section, growing on one side only (?), at an acute angle, and parallel to one another, causing the zoaria to assume a pinnate form, zooecia undefined, in a double row, apertures alternating; front surface with large oval perforations. Orifice circular; peri-stomes raised. Dorsal surface with oval pores in very regular parallel lines.

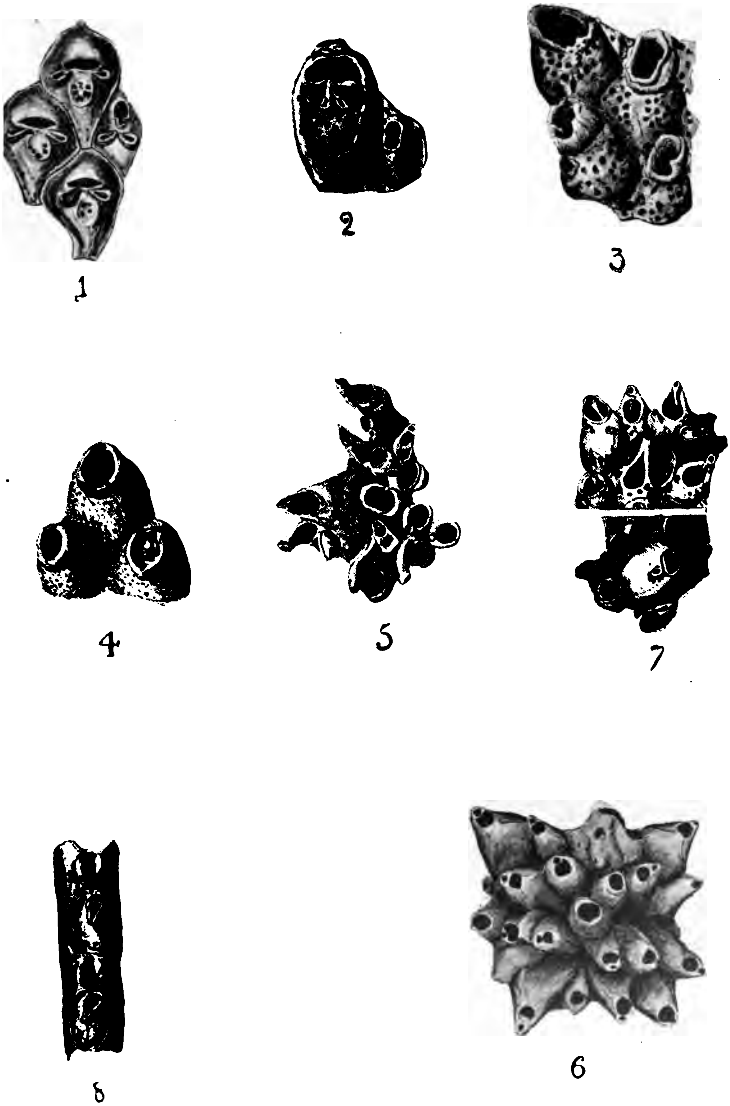
Locality.—Aire Coastal Beds (Hall and Pritchard).

This is a most elegant species; it is generally found very fragmentary, but in one lump of clay there was a specimen with several branches, which unfortunately broke up in the cleansing process.

This species in some measure shows the difficulty above alluded to, that there is in dealing with the Cyclostomata at present. The regularity of the disposition of the zooecial apertures would place it in Idmonea according to the older authorities; though as it is "free" (not encrusting or adherent) it would be placed by some later ones in Crisina; but as the walls of the zooecia are perforated in the same manner as those of Hornera I place it in that genus and would associate with it Idmonea hochstetteriana, Stol. The family Horneridae, to which this last genus (Hornera) belongs, Dr. Gregory, in his Catalogue of the Cretaceous Bryozoa in the British Museum, includes in a new sub-order Cancellata, which removes this genus far away from Idmonea.

EXPLANATION OF PLATES XVI., XVII.

Fig. 1.—Dimorphocella pyriformis, n. sp.
„ 2.—Dimorphocella triton, McG.
„ 3.—Phylactella cribrosa, n. sp.
„ 4.—Schismopora circumvallata, n. sp.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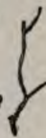

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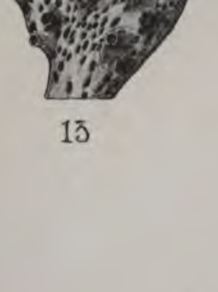

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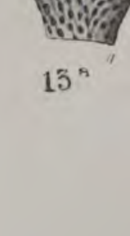

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Fig. 5.—Schismopora otwayensis, n. sp.
„ 6.—Cellepora stellata, n. sp.
„ 7.—Solenopora tubulifera, n. sp.
„ 8.—Retepora uniserialis, n. sp.
„ 9.—Retepora airensis, n. sp.
„ 10 and 10*a*.—Retepora delicatula, n. sp.
„ 11 and 11*a*.—Retepora arborescens, n. sp.
„ 12 and 12*a*.—Retepora complanata, n. sp.
„ 13 and 13*a*.—Hornera airensis, n. sp.

ART. X.—*Glacial Deposits at Taminick, Glenrowan and Greta, North-Eastern District, Victoria.*

BY A. E. KITSON, F.G.S.

[Read 11th June, 1903.]

The occurrence of glacial deposits in the North-Eastern District of Victoria has been known for many years. They have been recorded by Mr. Norman Taylor[1] from Rutherglen and Springhurst, and Mr. E. J. Dunn has observed them at Eldorado and Tarrawingee.

Later on Mr. W. H. Ferguson mapped a number of disconnected occurrences in the Greta and Hansen districts, and two near Pelluebla in the Tungamah district. There are also indicated on the new geological map of Victoria two areas at Wooragee.

These occurrences are principally in the basins of the Doma Mungi or Black Dog Creek, and of the King and Ovens Rivers, between Futter's and Tatong Ranges on the west, and the Pilot and Black Ranges on the east.

In the Taminick and Glenrowan districts no previous record of glacial deposits has been made, while those in the Greta district, though already mapped, have not yet been described. A few remarks will therefore be made upon them before dealing with the Taminick and Glenrowan occurrences.

GRETA DEPOSITS.

In the parishes of Greta and Laceby, between the King River and the Fifteen Mile Creek, there are no fewer than 14 inliers of glacial deposits varying in area from about 10 acres to 3 square miles. They occur in the broad plain west of the King River. The most northerly occurrence, on the boundary between the two parishes, may be taken as a typical example, and described in a

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1 Geological Report on the North-Eastern District. Prog. Rep. Geol. Surv. Vic., No. viii., p. 37.

general way. It covers an area of about 800 acres, forming a hill rising to the height of about 120 feet above the general level of the surrounding flats, and about 680 feet above sea level. This hill will be referred to as Mundara, since Mr. A. H. Smith's residence, "Mundara," is picturesquely situated on its northern slope.

The principal material visible on the hill is a yellow and reddish-yellow finely sandy and gravelly clay with pebbles and boulders. The colour of this material may be due to decomposition, but as no natural or suitable artificial section was visible the colour of the underlying material could not be ascertained. What can be seen, however, has the appearance of till. On the north-western side of the hill, among the debris thrown out of an old well—now filled up—are pieces of finely sandy and micaceous shale or fissile mudstone, with small patches of comminuted carbonaceous matter, like fragments of plants. This material is fairly calcareous, and of olive-green colour. Whether it occurs as a stratum, or only as a large boulder, cannot be determined on the visible evidence.

Scattered rather plentifully over the surface of the hill are numerous small and large pebbles, and a few boulders of grey and brown quartzites, lydianite, plain, banded and brecciated cherts of various colours from white to black, quartz, agates, indurated and normal sandstones and mudstones, fine and medium conglomerates, quartz and felspar felsites, and grey and red granites; while blocks of granite can be seen embedded in the material at the surface. Many of these sandstone pebbles and blocks contain casts of brachiopods of the Silurian period, similar to those stated[1] by Mr. Norman Taylor as occurring in the glacial deposits at Springhurst. Fine examples of these are in the possession of Mr. A. H. Smith.

Many of the pebbles are polished, widely grooved, and bear numerous striae. Some of them have one side smoothed and rounded, while the other side is sharply broken, or split off longitudinally, as if along a joint plane. The striated pebbles are chiefly of yellow, grey, and brown quartzites, and siliceous mudstones.

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1 *Op. cit.*

On the top of the hill there occur several blocks and pieces of red granite much resembling that of Futter's and the Mokoan Ranges. The striated pebbles are fairly numerous, and on some of them the striae are not sharp and clear, but much worn on the edges, as if indicating long-continued weathering. Extended and careful collecting would probably result in examples of other rocks and fossils than those named being obtained.

Glenrowan and Taminick Deposits.

These deposits occur in the valley lying between Futter's Range on the east and the Mokoan Ranges on the west, from 3 to 4 miles north-west of Glenrowan, a station on the Melbourne to Sydney railway, 136 miles from the former city, and 747 feet above sea level.

They prove the westward extension of these North-Eastern glacial deposits. No similar deposits have, as far as ascertainable, been recorded within a distance of at least 40 miles to the west of Futter's Range.

There are here three inliers of the material. The largest one occurs in allotments 44A, 44B, 45A, 45B, 45D, 61, 61A, 62, 62A, 65, parish of Glenrowan, and forms a hill known as Canning's Hill.

Canning's Hill.

This hill is essentially composed of claystones, sandstones and slates belonging probably to the Ordovician system. Overlying them are the glacial deposits, about 50 feet thick, which probably belong to the Permo-Carboniferous (Carboniferous) system.

A thin cap of basaltic soil and basalt, about 25 feet thick, possibly of the Eocene period, covers portion of the glacial area. The whole occurrence comprises an area of about 250 acres.

The greater part of the glacial deposit consists of clayey gravels with loose pebbles of agates, quartzites, cherts, indurated sandstones and mudstones, granites, felsites, schists, quartz, etc. In fact, with the exception of fossiliferous sandstone and calcareous mudstone, which were not observed, the rocks of the pebbles here are similar to those at Mundara. Though most of the material as seen is loose, there are parts of the hill where large blocks of highly indurated ferruginous grits and breccia-conglom-

erate are visible. These consist of rocks similar to those of the loose pebbles, and seem to have been formed by the binding together of the underlying deposits by the action of perlocating water from the once overlying cap of basalt. The breccia-conglomerate and grits are, therefore, younger than the glacial deposits. Fragments and small blocks of them occur among the pebbles on other portions of the hill.

Along the flank of the hill on its north-western side there is a reddish-yellow clayey soil, greatly resembling that constituting the main mass of the deposits at Mundara. Lumps of granite similar to that of Futter's, and the Mokoan Ranges occur loose on the surface among the large blocks of ferruginous breccia-conglomerate.

With reference to glaciated pebbles, it may be mentioned that in only a few cases have undoubted striae been observed. The general shape of the pebbles, however, combined with the great general resemblance between these deposits and those at Mundara, and the occurrence of the few finely striated pebbles appear to be sufficient evidence to prove their glacial origin.

The nature of the underlying Ordovician? strata has been ascertained by shafts sunk through the basalt near the top of the hill. Two of these shafts bottomed on the Palaeozoic sandstones and slates at 40 feet, after passing through from 20 to 25 feet of soil and decomposed basalt, and from 9 to 20 feet of glacial material; the other bottomed on similar sandstone at 22 feet, after passing through 12 feet of soil and decomposed basalt, and 10 feet of glacial material.

In the glacial material a little fine and coarse gold was found, but not in payable quantity.

Canning's Hill rises to the height of about 60 feet from the flats to the south, or about 650 feet above sea level.

The basalt on the hill is of exceedingly fine texture, and dark blue colour, weathering with grey and brown surfaces into a chocolate soil. Numerous rounded pieces litter the surface of the hill on its highest position, and the general appearance of the rock is similar to that of the "Older Basalts" of Victoria. The occurrence of this small outlier here is of interest, since no other basalt occurs in the district. The nearest known occurrence is that on the divide between the Boggy and Fifteen Mile Creeks,

a distance of 14 miles in a direct line to the south south east. The altitude of this basalt is somewhere about 2000 feet.

The question of whether or not it is a collection of basaltic material brought down by the same agency as transported the pebbles, or is the remnant of an old volcanic flow filling an old valley is one that deserves consideration. A microscopical examination is necessary to determine whether it is a true "older basalt," or a representative of the melaphyres, similar to those of the Upper Devonian series, which so closely resemble the "older basalts" in general appearance. If the latter, by no means an improbability, it will be of assistance as pointing towards a southern origin for the glacial deposits, since the nearest known representatives of Upper Devonian strata occur at Toombullup, about 16 miles to the south.

The other two occurrences of glacial deposits occupy small areas in the parish of Taminick, about one mile to the north-north-west of Canning's Hill. They both form low hills, or rather hillocks, rising to the height of about 25 feet above the flats.

Sadler's Hill.

The more easterly one comprises an area of about 30 acres in allotments 32A and 33A, and will be referred to as Sadler's Hill, since the greater part of it is on the property of Mr. J. R. C. Sadler. The material here is more distinctly of a gravelly and pebbly character than that on Canning's Hill, and no reddish-yellow soil was observed. No pebbles showing distinct striae were found, still, as a prolonged search was not made, it is quite probable they do occur here. The deposit is otherwise similar to that on Canning's Hill.

Cox's Hill.

The other deposit occurs in allotments 18 and 19, owned by Mr. Geo. Cox, and lies half a mile to the west of Sadler's Hill. It has an area of about 35 acres, and will be referred to as Cox's Hill.

Reddish-yellow soil, similar to that at Canning's Hill and Mundara, occurs here. Large and small pebbles are numerous on parts, and though none shows undoubted striae, several of

those found are polished, widely grooved, and have the general appearance of glacial stones. They also show the longitudinal splitting and transverse fracturing so noticeable among the pebbles at Mundara. It is, therefore, by analogy almost wholly that these two occurrences are regarded as of glacial origin. There is, however, to my mind, no doubt about the matter.

It is very probable that they, or at least the visible portions of them, are redistributed glacial material.

All these occurrences lie among the late Cainozoic or younger loam and clay of the wide valley between Futter's Range on the east, and the Winton and Mokoan Ranges on the west and north-west. Futter's Range consists of a grey and red granite of fine and medium texture, as well as of aplite, while the Mokoan Ranges are composed of similar granites and aplite, and early Palaeozoic strata, probably Ordovician or even pre-Ordovician. The granite is distinctly intrusive, and can be seen to ramify the sediments in many places along the southern and eastern flanks of the latter. The Winton Ranges consist of altered sediments similar to those of the Mokoan Ranges.

Along the valley to the north of Sadler's Hill, and distant from it some 70 chains, there is another inlier of Ordovician? strata, forming a hill rising to about 50 feet above the flats. No glacial deposits similar to those on Sadler's, Cox's and Canning's Hills are observable on it. The same may be said with regard to several similar inliers in the same valley, but to the west and south-west of those mentioned. The reason of this is not apparent, assuming the glacial deposits to have originally been portion of one mass, and the question as to whether they are due to a glacier or to floating ice is one that can hardly be settled on the present available evidence.

Art. XI.—*Volcanic Necks at Anderson's Inlet, South Gippsland, Victoria.*

By A. E. KITSON, F.G.S.

(With Plates XVIII., XIX.).

[Read 11th June, 1903].

In his valuable Report on the Geology and Mineral Resources of South Gippsland,[1] Mr. R. A. F. Murray, late Government Geologist, thus briefly describes an occurrence of volcanic rock, and illustrates it by a section and ground plan:—"Fig. 7 illustrates the section at Townsend Bluff, with an apparent lava pipe, which occurs in a circular form, about 20 yards in diameter."

Having for a long time desired to see the occurrence, it was not until recently that an opportunity was afforded to do so. A close examination then disclosed the fact that a most interesting geological occurrence was here visible. Its intimate connection with, though considerable diversity from, volcanic occurrences in the adjoining district makes it necessary to allude briefly to the latter. Before doing so, however, it will be advisable to make a few remarks on the general geology of the district.

From the accompanying map of the geology of this portion of South Gippsland, which map is based on the new geological map of Victoria, compiled by Mr. Arthur Everett, it will be seen that between the Tarwin and the Bass Rivers, the country may be divided physically into two general divisions, and geologically into four.

Physiography.

Division 1.—Between the Bass and the Powlett Rivers the country consists of rugged hills reaching an altitude of over 1000 feet near Korumburra. They are much broken by faults and landslips, and form steep escarpments along the valleys of the two rivers. Numerous small streams run through it, the tributaries of the Bass having a general westerly course, while those of the Powlett run in a southerly direction.

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1 Prog. Rep. Geol Sur. Vic., pp. 143, 144.

Division 2.—Between the source of the Powlett and the Tarwin Rivers the country consists of undulating plains, rising to the height of over 300 feet above sea level near Leongatha, and extending to the Southern Ocean and Anderson's Inlet, either gradually, as along the valleys of Pound, Screw and Wreck Creeks; or terminating abruptly in cliffs up to 100 feet high, as along the coast from Wreck Creek to west of Cape Paterson.

Geology.

Division 1.—The country between the Bass and the Powlett Rivers, with the exception of a small area to be mentioned later, consists almost wholly of felspathic, argillaceous, calcareous and carbonaceous sandstones, shales and mudstones of the Jurassic[1] system. They contain numerous seams of good black coal. These seams are chiefly thin ones, varying from less than one inch to six feet. Within this area are situated the Victorian Coal Fields of Outtrim, Jumbunna and Korumburra.

Dispersed throughout the district, particularly in the basin of the Foster, are numerous localised volcanic occurrences, comprising plugs and dykes of dolerite and basalt, with apophyses therefrom, representing the necks of old volcanoes. They vary in extent from the largest reaching a surface area of about 30 acres, to the smallest, occupying but 3 square feet. The exception previously referred to is an area of about 250 acres at Kongwak on the Foster, where an inlier of Silurian occurs.

Division 2.—The country between the Upper Powlett, the western tributaries of the Tarwin, and the Tarwin itself is diverse in character.

Around Leongatha and north of Ruby it is mainly of volcanic origin, comprising laterite, flow basalts and tuffs. There are, however, strips of pebbly gravels, and these, and the volcanics rest on Jurassic sandstones near Ruby. These gravels belong to the Cainozoic system.

Division 3.—Between the Middle Powlett (that part of the valley south of Outtrim), Anderson's Inlet, and the Lower Tarwin

1 These strata were formerly referred to by the Geological Survey of Victoria as Jurassic, and later on as Trias—Jura. A reversion to the former name has, however, now been made.

there is a wide stretch of country constituting the Powlett and Tarwin Plains, covered in the main with pebbly drift, gravels and sands, with a few isolated patches of laterite tuffs and plugs of basalt.

Division 4.—Between the Middle and Lower Powlett and the coast there is a varying, though thin, capping of sediments, chiefly clays, and sands of æolian origin covering the Powlett Plains.

The greater portion of the coast line itself is composed of Jurassic strata forming bold cliffs. This series extends to the hill country, underlying the thin covering of Cainozoic sediments over the greater part of the area. Jurassic rocks are visible at the surface for some little distance inland from the coast between Wreck Creek and Cape Paterson; while between Cape Paterson and West's Creek there are two inliers of Silurian strata, discovered by Mr. W. H. Ferguson, during the progress of his survey of the Cape Paterson Quarter-sheet.

During the progress of my survey of the Jumbunna Quarter-sheet, extending from the Powlett Valley to Korumburra, numerous small and large volcanic plugs and stumps of old volcanoes were found, as has already been mentioned. They have been intruded into or thrust through the carbonaceous strata of the Jurassic system. They comprise three general types of rock:—

(*a*) A coarsely crystalline rock, probably dolerite, comprising the largest neck, and several smaller ones.

(*b*) A dense olivine basalt with large included crystals of hornblende, biotite and felspar scattered through it, besides fragments and blocks of the invaded strata, and usually occurring as small and medium plugs.

(*c*) A dense or finely crystalline basalt as a rule, with or without amygdules of calcite, and small patches of olivine. This occurs as small plugs and dykes.

An occurrence similar to these was, therefore, expected at Townsend Bluff, but examination revealed a neck of different character. Though containing a considerable amount of basalt it consists for the greater part of clastic volcanic material such as agglomerate, tuff, lapilli, and what appears to be volcanic mud with included blocks and fragments of the adjacent Jurassic

strata, and decomposed basalt of different character to that of the basalt in mass.

I was also informed by Mr. A. Cuttriss, a resident of the locality, that basalt occurred in two places in the cliffs further to the east. The locality indicated was subsequently examined, and furnished three additional examples of necks, one of them of much greater size than that of Townsend Bluff. For the most part these occupy an area beyond tidal influence, so that their characters are not nearly so well shown as in the smallest, but splendid example to the west. They, however, possess features distinct from this one, and will be described in detail in their turn.

For the sake of convenience the necks will be referred to by numbers, commencing with that at Townsend Bluff.

Volcanic Neck, 1.

This neck is located at Townsend Bluff, at the mouth of Screw Creek, on the beach opposite allotment 2, parish of Drumdlemara. It occurs among Jurassic sandstones, shales and mudstones, planed down fairly level, and exposed at low tide. It has a roughly circular shape with irregularities, the greatest one forming a pronounced bulge in the south eastern portion. Its diameter in this direction, as far as visible, is about 25 yards, while a north and south diameter is about 21 yards. Nearly the whole of the periphery is visible.

For a considerable portion of its periphery, especially on the north, west and south there is a narrow shell—if it may be so called—of a finely vesicular scoriaceous basalt, or mud basalt. This has a laminated appearance, the jointing being vertical, or parallel with the wall of the neck. This shell stands up above the general level of the neck, owing to its greater resistance to decomposition and wave action. Owing to its jointed character it is impossible to obtain a museum specimen, and it weathers into a ragged surface. This shell is only a few inches thick, but similar material, though quite decomposed, and still exhibiting its laminated appearance extends for some few feet into the neck. There are, however, several isolated patches of the hard rock in the body of the neck, the largest one occupying the visible south-

eastern portion of the neck. Whether or not it extends to the margin of the neck could not be determined, as sand, mud and sea-weed obscure the surface.

The main portion of the neck consists of agglomerate, formed of a heterogeneous mixture of blocks and fragments of decomposed basalt, different in character from that present in a hard state; Jurassic strata, such as sandstones, shales and mudstones; tuff, lapilli, and a material that looks like a volcanic mud. The included fragments of Jurassic strata are in some cases considerably indurated, but generally show little evidence of alteration. In the northern portion this material is of finer texture, and shows rude prismatic and spheroidal structure. Along the southern edge for several yards in two separate streaks, lying between the laminated basalt and the containing sandstones, there occurs vertically laminated tuff, varying from a quarter of an inch to 9 inches in thickness. The included blocks of Jurassic sandstones, mudstones and shales range in size up to 6 feet by 4 feet, those of decomposed basalt being much smaller.

The northern portion of the neck runs out into a sharp point where the contiguous fine argillaceous sandstone shows distinct curved structure on a small scale, the jointing being about vertical, and following the curve of the adjacent part of the periphery.

The sandstone is slightly hardened, but otherwise not altered.

The Jurassics here form portion of a dome which extends along the beach in a north-easterly direction. The neck has been formed in the north-western portion of this dome. The contiguous strata dip generally N.W. at about 28 deg. on the north-western edge, and curve a little to the N. along the northern edge. Numerous faults may be seen, but their characteristics cannot be definitely ascertained owing to the overlying sand, mud and water. They will be briefly described under a separate head.

Volcanic Neck, 2.

This neck is a much larger one than Neck 1, in fact it is the largest of the group. In character it differs greatly from Neck 1. Almost its whole visible portion consists of an agglomerate.

It has a visible length from north to south of about 12 chains, and a visible breadth of about 8 chains. It appears both at and

below high-water mark, and in the cliff, where it forms a distinct swelling in the coast-line. Below high-water mark it can be seen fairly well in some places, though the greater portion within tidal influence is covered with sand and mud. It disappears beneath the northern channel of Anderson's Inlet with a breadth of some six chains, and probably continues in a south-south-easterly direction for several chains more. Neither its eastern nor its western margin can be seen, owing to mud and sand, but the occurrence of basalt and agglomerate three chains to the east of the visible margin probably proves that it extends easterly for that distance.

Jurassic sandstones, however, which outcrop close to this spot, clearly limit its further extension in that direction. On the western side no rock is visible among the mangrove-covered mud and the sand of the channel west of a southerly line along the visible western margin.

In the cliffs the eastern and western margins are both marked by small gullies. On the opposite side of each of these gullies the grey soil from the Jurassics affords a clear distinction from the black soil of the volcanics.

The form of this neck as seen is, therefore, roughly that of a truncated ellipse. By far the greater visible portion of it consists of agglomerate, the main mass of which is composed of coarser fragments than that of Neck 1. It contains fair-sized lumps of hard dense fine-grained, highly-spheroidal basalt, with patches of green olivine. In the cliff the agglomerate can be seen in undecomposed blocks constituting a very hard rock. On the beach, where, subject to the action of salt water, it is, as a rule, quite decomposed, when the contained fragments can be easily separated from the matrix. Some of the agglomerate, again, is an intimate mixture of dark dense basalt in small fragments, calcite, and an amorphous or crypto-crystalline, pasty-looking material. It weathers with a brown surface, on which the fragments of basalt show as dark blotches.

There are several kinds of basalt distributed through the mass. One found near the foot of the cliff is a very dense dark basalt of medium texture and high specific gravity. It contains a good deal of calcite, which occurs in amygdules, as films along joint planes, and in patches merging into the basalt. It decomposes

with a reddish-brown surface, but forms a fairly dark soil. A fair-sized patch of similar rock occurs on the beach under high-water mark. It wears into ragged edges.

A very vesicular basalt, of fine texture and brownish-grey colour, occurs as a block among agglomerate in the cliff. The vesicles are apparently caused by the decomposition and removal of the carbonate of lime from amygdules of calcite. There is also a little lapillaceous tuff, consisting for the most part of fragments the size of peas, and showing distinct bedding. It has a considerable amount of greenish-grey volcanic mud, and blunted pieces of the fine decomposed basalt up to the size of pigeons' eggs. A pretty rock of light drab-grey colour, grading to yellow at the surface, a decomposed basalt, occurs as an inclusion in dense basalt on the beach, west of the private jetty built by Mr. Cuttriss. It is composed of multitudes of thin, narrow, transparent, colourless crystals up to one-sixteenth of an inch in length, set in a matrix of yellowish clay, probably decomposed felspar. Another kind of decomposed basalt of light grey and yellow colours occurs at this spot. It is an intimate mixture of minute crystals with occasional vesicles of clay. It resembles very much the included pieces of decomposed basalt in the agglomerate of Neck 1.

There are two other rocks found in this dense basalt which are of interest. One is of dense, hard, dark blue amorphous material with small amygdules of yellowish-brown ferruginous powder. It is a rock with a peculiar appearance, and gives one the impression of being a form of a mud lava or basaltic mud. It also contains small patches of olivine, partially altered about the edges into an opaque white substance. Small lenticles of this hard amorphous material also occur in parts of the agglomerate in the cliff, and they would probably be turned by decomposition into the brownish-grey mud comprising the lenticles in the decomposed agglomerate on the beach.

The other rock is a light and medium grey compact mud, with numerous very small amygdules of a brown glassy mineral. The rock weathers a light grey, and is a good deal like the last mentioned. They both appear to have been formed from the solidification of pasty material of basaltic origin, perhaps crushed or ground-up basalt mixed with liquids, and to have gained their

olivine crystals from this rock, or picked them up as fragments during movement in the neck.

Included Pebbles.

The special feature of interest in this agglomerate is, however, the presence of numerous small and medium-sized pebbles and fragments of pebbles. These occur in some places in considerable numbers, and may be seen either lying loose on the surface of the disintegrated material, or embedded in the matrix. The pebbles range from the size of mere gravel to that of a goose's egg. In fact, one large pebble of quartzite was found on the mud-covered surface east of the jetty, but within the boundary of the neck. This pebble weighs several pounds, and is 8 inches long by 5½ inches broad and 3½ inches thick. Judging by its appearance when found, and its location, it had apparently been disintegrated from the subjacent material. These pebbles occur chiefly towards the southern end of the neck, west of the jetty, but they probably also occur between here and the foot of the cliff. Drift and blown sand, however, covered with tea-tree, hide the surface of the neck from sight. A few pebbles are also obtainable from the soil in the cliffs.

Comparatively few of them occur entire. Most of them have been transversely fractured, or have lost chips. Their general shape is a flattened oval; some are cylindrical; others rounded and flattened, oval truncated, flat, quadrangular and semi-rounded and irregularly shaped with flattened sides. A few show rude facetting. They comprise the following rocks, as well as can be determined roughly, viz: olive mudstone; red, brown, yellow, dark black, blue and reddish-brown plain and banded jaspers, odd ones showing thin streaks of white silica; greenish-grey and bluish-grey slightly pitted rocks like hornstone; yellowish-white quartz schist; fine to coarse yellowish-white, bluish-grey, brownish-grey and white sandstones, some with thin quartz veins; white, yellow and rose quartz of various kinds, transparent and opaque, semi-opaline, chalcedonic, and opaque-white, with thin transparent veins of silica; plain and banded quartzites of grey, brown, bluish-grey, black, and reddish-grey colours, and a blue variety showing a network of white veins; altered quartz—

conglomerate of grey colour; grey, greenish-brown, yellow, bluish-grey, white, grey and black plain cherts, and black, grey, white, brown and dark-blue mottled cherts; a grey-coloured rock like quartz felsite; white and pale yellow chalcedony, with very pitted ragged edges; carnelian; chalcedonic breccia; brown spherulitic rock like quartz-felspar-felsite; silicified wood; and an igneous rock that looks like a very dense basalt or melaphyre. It is a crystalline rock with felspar and small green crystals like olivine, and is of medium grey colour.

Some of the cherts have a fragmental appearance, and they all are extremely like the rock of some of the pebbles of the Cainozoic gravels of the Powlett and Tarwin Plains. They have undoubtedly been derived from the same source, or from similar rock masses.

The silicified wood has the same general appearance as much of that found among Jurassic strata in the State. A microscopical examination is, however, necessary before a conclusion can be arrived at as to its Jurassic age. Certainly the Silurian or older strata did not furnish it, and there is no evidence of the occurrence of any younger Palaeozoic strata anywhere near this district, even if plants of the nature represented by the wood flourished during those periods. The silicified wood may, nevertheless, belong to the Carboniferous or Devonian period, and have been transported in a silicified state by driftwood, floating ice or floating islets far from its home. The occurrence of large blocks and small trees lying prone among fine and coarse sandstones, and including among the roots of the trees a bluish or olive mudstone quite distinct from the containing strata, clearly indicates their driftal origin.

Should, however, this silicified wood be determined as Jurassic, it proves that silicification of some at least of the carbonaceous material in the Jurassic strata was carried out during the Jurassic period.

VOLCANIC NECK, 3.

This neck lies to the north-east of Neck 2, and about 6 chains distant from its northern end. Jurassic strata occupy the intervening area, as evidenced by the soil, and pieces of rock in water channels.

The visible portion has a length of about 3½ chains, with a breadth of about 1½ chains, the whole of it as seen being in the cliff and slope of the hill. It has a general south-easterly bearing, and probably extends for some distance out into the flat, but as the flat is here covered with drift and blown sand, nothing beneath is visible. Even in the cliff the nature of the material constituting the neck cannot be clearly determined.

As far as can be seen the neck consists of a plug of dense, hard, dark blue basalt, forming a low swelling on the top of the cliff, and extending in a south-easterly direction down to the flat. As it approaches the flat it narrows very much, and appears to be only a few feet wide at the foot. This basalt apparently forms the eastern margin of the neck. On the western side of the neck there is a considerable quantity of tuff, containing a few pebbles similar to those in Neck 2. Those obtained vary from the size of a small marble to that of a pigeon's egg. There are, also, visible on the surface, pieces of agglomerate and fine and medium-grained decomposed basalt, similar to that in Necks 1 and 2. There are, besides, pieces of what looks like volcanic mud—an amorphous or crypto-crystalline, soft, compact material of dark grey colour. It resembles, somewhat, the small lenticles referred to in one of the basalts of Neck 2, and also that obtained from another volcanic occurrence, probably a neck, situated in allotment 97, parish of Leongatha, to the north-east.

Volcanic Neck, 4.

Separated from Neck 3 by Jurassic strata, and distant from it 5 chains to the east lies Neck 4. Its western margin is clearly defined by a small gully, but on the eastern side there is nothing definite to aid one in fixing its margin. The visible portion of this neck also occurs in the cliff, but probably extends in a southerly direction into the flat, where, however, sand obscures the view. As far as can be seen, it is oval in shape, its length in an east and west direction being about 6 chains, and breadth 2 chains.

It, again, differs from the preceding necks, inasmuch as it is almost wholly composed of a homogeneous grey tuff containing grains of sand and a few pebbles similar to those in Necks 2 and

3, but much smaller than the average size of them. Towards its eastern margin there is a dyke or plug of basalt having a width of about 6 feet in the cliff, and a N.W. and S.E. bearing. In the flat to the south-east two drains reveal a dyke of basalt 10 inches wide, having the same general bearing as that in the cliff. Probably it is the southerly extension of that dyke. This basalt is a hard, dark blue, dense rock, much like that in the plug in Neck 3, and it contains amygdules of calcite and patches of green olivine. It weathers a grey colour like that of the soil from the Jurassics, and can be traced up the cliff for some 2½ chains. The latter part of its course is through Jurassic strata, the former through tuff. It is probably somewhat younger than the tuffs of the neck, though practically contemporaneous with them.

Packed up against the foot of the cliff, here about 30 feet high, are blocks of a dense, hard, coarse olivine basalt, and a few loose pieces of agglomerate thrown out of drains on the flat. The olivine occurs in patches over 1 inch in diameter. It is, therefore, probable that the neck extends for some little distance into the flat, where it may partake more of the character of Neck 2.

The tuff of this neck differs from the ordinary tuffs of the district. It has more of the character of a friable, granular, rather incoherent clay, and contains numerous grains of quartz sand. It induces the belief that it consists of a mixture of sedimentary and volcanic material, and this it probably is. The absence of a greater proportion of sand grains may be explained by supposing most of the visible material to be a mixture of Jurassic mudstone in a pulverised state, with volcanic dust or fine tuff.

Other Local Volcanic Occurrences.

In addition to the basalt showing within the boundaries of the volcanic necks, there are several other occurrences of this rock among the Jurassic strata. Three of these occur close together, between 6 and 8 chains north-east from the northern end of the jetty. The most easterly one is a dyke of basalt, 6 inches wide and about 20 yards long, having a N.E. bearing. The rock is a dense black basalt of fine texture.

The most westerly one is a narrow dyke 1 foot wide and 15 feet long, bearing 312 deg. The rock is a dark blue rock of medium texture.

The middle, and much the largest, one has the shape of a lenticle truncated at both ends. It has a bearing of north and south, with a length of about 15 yards, and breadth at north end of 4 yards, and at south end of 4 feet. It is composed of a highly spheroidal, slightly vesicular, rock. This is highly decomposed, and differs in character from the basalt of the necks. It appears to be more of a mud basalt, and peels off into thin shells.

The last local occurrence of basalt to record is what appears to be a dyke branching from Neck 4, either from the dyke on its eastern margin, or from some larger body of basalt in the flat, hidden from view by sand. Small blocks of it can be seen at the foot of the cliff on the eastern boundary of allotment 3, parish of Drumdlemara, within which allotment are also embraced Necks 3 and 4, and portion of Neck 2. This dyke can be traced for at least 2½ chains west from the boundary, and also for some distance to the east. It has a general bearing nearly east and west.

Adjacent District Volcanic Occurrences.

Before leaving the consideration of the necks, it is advisable to mention several occurrences of laterite, basalt and tuffs that occur in the plains to the north and west of the Inlet area. Five of these, occurring in allotments 9, parish of Kirrak (M. Ruttle); 31, Kirrak (W. Watson); 30A, parish of Kongwak (A. Blew); 37, Kongwak (J. McDowell); 38, Kongwak (R. W. McDowell) consist of laterite and tuffs with lapilli. Three others, occurring in allotments 23C, Kongwak (E. O'Connell); 41A, Kongwak (Beard); 97, parish of Leongatha (L. Follgrabe) and 25, Leongatha (D. Millar), consist of laterite, tuffs with lapilli, and basalt. One of basalt only, but occupying an area of only a few square yards, occurs in allotment 55A, Drumdlemara (M. Crowley). There are several other places on the plains nearer Leongatha, where volcanic rocks occur, but these I have not examined, so cannot discuss them. One notable example, however, near Cape Paterson, exposed on the beach at low tide, may be mentioned.

It is more of the character of the necks in the hill area, and consists largely of basalt, with no tuffs. Mr. Ferguson, who has examined it carefully, tells me that he regards some of the material as an agglomerate, so perhaps it may be included among the series characteristic of the plains area. These will be dealt with in the official reports of the surveys of the areas, so no further description of them will be given here, save to mention that Watson's tuff occurrence has the character of a fissure neck. It is a long, narrow strip of laterite and lapillaceous tuff, traceable almost continuously for a length of nearly 40 chains, with an average width of about 2½ chains.

All of these are probably volcanic necks, and not remnants of extensive beds of tuff and flows of basalt. There are, probably, numerous other occurrences of tuffs and basalt distributed over the plains, but hidden from sight by the thin covering of sediments present.

Age of the Volcanic Necks.

Speaking in general terms, the age of the volcanic activity, of which the necks furnish evidence, can be set down with some degree of certainty. That it is post-Jurassic, of course, admits of no question. There seems almost conclusive correlative evidence that it was contemporaneous with the "Older Basalt" of the Mornington Peninsula and Western Port region. There, in sea cliffs along Western Port, the Cape Schanck coast, and at San Remo, basalt and associated tuffs can be clearly seen.

Resting on this basalt at Flinders is a small isolated patch of Bryozoan limestone[1] of Eocene age, so clearly the basalt there belongs to the Eocene or pre-Eocene period.

In various localities, such as at Berwick, Bacchus Marsh, Dargo High Plains, etc., leaf-bearing clays of probably Eocene age, underlie these basalts. There seems, therefore, no strong reason to doubt that the necks belong to the Eocene period.

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1 Pritchard, G. B.: The Geology of Flinders, "The Victorian Naturalist," February, 1903; Kitson, A. E.: Report on the Bryozoan Limestone at Flinders, "Records Geol. Sur. Vic.," vol. i., part i., 1902.

DIFFERENCE BETWEEN STRUCTURE OF THE VOLCANIC NECKS.

The cause of the difference in structure between the necks in the Jumbunna hill country, and those in the Anderson's Inlet and Powlett Plains series is, apparently, due to a difference in altitude. Those in the former district, which, without observed exception, are composed of basalt, and have no agglomerate or tuff, represent probably the lower portions of volcanic necks; while those of the plains series consisting of tuffs only, or of tuffs and agglomerate, or of tuffs, agglomerate and basalt, are probably the higher portions of similar contemporaneous necks. Ages of denudation have in the former case worn away the upper portions of the necks in the Jumbunna series, together with the contiguous Jurassic strata, and all of the younger sediments, if any, which overlay them. In the latter case, owing, probably, to protective covering and lower altitude, this upper portion of the necks has been preserved, and is only now undergoing denudation.

The conclusion is then forced upon one that the plains series were at one time at a greater altitude than the former. What then accounts for the reverse difference in present altitude? Faulting seems to be the cause, and faulting on a large scale. In dealing with an area such as this of the plains, covered as it is with a thin series of clays, sands, gravels and pebbly drift, and devoid of natural or artificial sections, it is impossible to obtain anything that serves as a definite stratigraphical guide or datum; and in the absence of the occurrence of similar deposits in the Jumbunna hill country one has to turn to the Jurassics themselves in the hope of finding evidence to assist in arriving at a conclusion.

A careful examination of every channel along the western and northern side of the Powlett Valley to the junction of Lance Creek with the Powlett has proved that in almost the whole of the cases in which dips have been obtainable, or the strata observable, they have shown an abnormally high angle of dip for Jurassic strata. The strata themselves have in several places been greatly compressed, crushed and tilted, and are so extremely like the highly-inclined strata of Silurian areas, both in structure and composition, as at first sight to raise doubts of their belonging to the Jurassic system. Dips of over 70 deg. are frequent, and

in s[illegible] case[illegible] he beds are almost vertical. The line of these dips follo[illegible] [illegible]sely the present escarpment of the Powlett Valley, and it is interesting to note that on receding into the hills the r[illegible] ecome less, and in a few chains become normal. [illegible] be said of such of the dips as have been obtained [illegible]her out on the flats. This seems to point conclusively towards a great earth movement or movements, and a general dislocation of the area to the south.

Additional evidence will probably be obtained in the Ruby district tending to further support the theory of great faulting of this region, but as, up to the present, nothing really definite has been obtained by me, that matter will not be further discussed in this paper. In the district to the north-east, Mr. Jas. H. Wright[1] has proved faulting to a great extent.

Faults associated with Volcanic Necks.

The question of faults associated with the intense volcanic action of the time when these necks were formed is one of importance. Unfortunately, owing to the very limited area which is occupied by rocks bared sufficiently to admit of the examination of their physical characters, there are no data on which to found any definite conclusions as to the influence of the volcanic intrusions upon the invaded strata. The limited area around Neck 1 is the only one where there is any opportunity of determining faults. Even there the rock masses, which are chiefly thick-bedded sandstones with no distinguishing features, and the overlying mud and sea-weed preclude definite evidence from being obtained, except in the case of two or three most pronounced ones. Near the foot of the cliffs, however, at Townsend Bluff there are two or three beds of carbonaceous shale, impure coal, and bluish-grey mudstones. These afford some assistance in reading the nature of the faults.

There appears to be sufficient to regard the existence of three series of faults, two directly connected with the intrusion of the neck, and the third possibly so. The first two series may be divided into those having a general westerly bearing; and those

1 Note on the Geological Features of an Area in South Gippsland. Prog. Rep. Geol. Sur. Vic., No. viii.

having a general north-westerly one. Two examples of each can be seen branching away from the periphery of the neck, but their mutual relations cannot be determined.

The third, represented by a well-pronounced fault, not visibly connected with the neck, has an almost east and west bearing, and has caused a visible dislocation of the strata, but to what extent could not be ascertained.

As far as can be gathered from the evidence of the first two series of faults there has been a general throw of from a few inches to a few feet to the west. This seems to indicate that the intrusion of the volcanic mass has caused a westward push on that side of the neck, dislocating the strata, and setting up simultaneous or subsequent formation of the larger faults of both series. The smaller ones were probably caused by the settling of the masses after their initial and greater movement.

On the eastern side of the neck there are three distinct and sharply-defined extensions of the volcanic material forming steps, as it were, in the margin of the neck. They probably indicate the points of origin of faults having a general easterly bearing, and similar in character to those in the west. That they do represent faults, however, is not evident, since the strata here—massive, jointed sandstones—quite prevent definite evidence being obtained.

With the exception perhaps of a marginal displacement of 2 or 3 inches at the most, and confined to the periphery or thereabouts, that is dying out in the neck itself, there does not appear to have been any displacement of the volcanic material after its injection and solidification. All the definite larger faults, with the one exception, have apparently radiated from a common centre, that of the neck itself, and are directly attributable to volcanic agency.

Continuing the examination of the beach eastward from Neck 1, it is seen that there is a series of almost parallel breaks in the sandstones. These are now marked by narrow channels or rifts, varying in breadth from 2 or 3 inches to 6 feet. They may represent lines of fault, or perhaps only lines of jointing, eroded by sea action. In two cases, however, there is evidence of definite faulting, one of them having a throw of 6 feet, and N.W. bearing. Little beyond the general bearing of the faults can be

obtained as, owing to surface material, the identification of any particular bed is a matter of doubt and difficulty.

The beach outcrops show the Jurassic strata here to form part of a dome of which the north-western, northern, and north-...stern portions are revealed by the dips near Neck 1, and the south-eastern portion by the dip east of the jetty.

The southern and south-western portion is of course hidden under the sands of the Inlet. The necks have thus been formed in an original dome of the Jurassics, or perhaps the dome has been caused by the raising of the strata due to volcanic action prior to the outburst of the neck.

Polished Pebbles in the adjacent Jurassic Strata.

As bearing directly upon the occurrence of pebbles in the necks a few special remarks must be made upon the presence of pebbles in the Jurassic sandstones among which these necks occur, or in ...ality at and near Savage's Hill.

...g on the surface, or in water channels, or exposed in ...ction in cliffs, pebbles of similar rocks to those described ...ks 2, 3 and 4 are by no means uncommon. I have ...ound numbers of them myself close to the eastern and western margins of Neck 4, and have also received a small collection from Masters John and Tom Cuttriss. These pebbles have such an exceedingly high polish as to attract attention immediately when seen. Here, as in the necks, they occur both as entire pebbles, and as fragments. Frequently they have been broken across their greater lengths, or have flakes and chips missing from their sides. This has been caused by perfectly natural means, and is not due to chipping by aboriginals, as pebbles are being found in channels, which are at present deepening through decomposing rock *in situ*, and under conditions which preclude their transport from younger deposits. They are also found in the decomposing rock in road cuttings and other excavations.

These pebbles are most interesting, both on account of their origin, the agencies responsible for their excellent polish, and their transport to the localities where found. They comprise felsites, mica schists, jaspers, agates, chalcedony, carnelians, cherts, quartzites, quartz, lydianite, altered sandstones, and

silicified wood. Most of these rocks are quite foreign to the district as far as known. Mr. Jas. Stirling records[1] a small outcrop of felsitic rocks at Waratah Bay, but no mica schists, cherts and jaspers have been recorded *in situ* within at least 30 miles of the spot. Though inliers of Silurian, such as those of Kongwak and the Powlett, do occur, there are no discovered remnants of older or more altered rock masses within it such as would furnish pebbles of the characters of some of those found. The evidence, therefore, is in favour of a comparatively distant origin for portion at least of the pebbles.

The polishing is not due to running water. Of this there can be no doubt. The only action to which it appears attributable is that of wind-blown sand, or wind-blown frozen snow.

The agency by which they were transported to their present position cannot have been the same as that which brought the finer sediments. Both on account of their size and the character of the rock they are composed of, this is quite impossible. The medium that conveyed or removed the material, chiefly felspathic quartz sand, from its source in a plutonic (probably a granite) area could not have brought down the heavy pebbles such as are found. The nature of the pebbles, also, suggests their derivation from a metamorphic area, which, if not more remote than that from which the sediments were derived, was, perhaps, quite a distinct one. Two means of transport suggest themselves: 1. That by driftwood; 2. That by floating ice.

Land Surface during the Jurassic Period.

Before briefly discussing these probable agencies, a few remarks may be made on the probable nature of the land surface bordering part of the basin in which the Jurassic sediments were deposited.

It seems probable that the pebbles were originally of glacial origin, and were derived indirectly from the disintegration of pre-existing glacial deposits on the margin of the Jurassic basin.

The occurrence of glacial deposits in north central and north eastern Victoria, as at Carisbrook, Wild Duck Creek near Heath-

1 Notes on the Silver Deposits and Limestone Beds of Waratah Bay. Prog. Rep. Geol. Sur. Vic., No. viii.

cote, P… …la, Glenrowan, King Valley, Springhurst, Tarrawingee and Wooragee, and in south central Victoria, as at Bacchus Marsh, and under the deep leads at Pitfield, prove that they were originally very extensive. The period to which they belong being now generally recognised as Permo-Carboniferous or Carboniferous makes it highly probable that during the Jurassic period much larger areas were covered by them than is now the case. Consequently the derivation of these peculiar pebbles from such deposits seems probable.

In general character and nature of rock the pebbles in the Jurassics have such a striking resemblance to those in the glacial deposits as to force the conviction that they have either come from the same or similar rock masses, from which the latter were derived, or that the glacials have indirectly furnished them.

Driftwood Theory.

Since most of the carbonaceous material and silicified trees and blocks of wood present in the Jurassic strata show distinct evidence of transport, and not growth *in situ*, it follows that this material must have been drifted. Whatever may have been the means by which the silicified wood—assuming it to belong to a period anterior to the Jurassic—was conveyed thither, the blocks and masses of carbonaceous material were probably brought by rivers into the Jurassic lake, on the surface of which they floated far and wide till, becoming waterlogged, they sank to the bottom. These masses of driftwood probably had entangled among them pebbles of various kinds, and thus may have been the means by which some at least of the pebbles were distributed among the Jurassic sediments.

Surface and Ground Ice Theory.

The Jurassic deposits, as far as yet known, appear to be wholly of freshwater origin, judging by the fossils hitherto recorded. The fauna is represented by three species of freshwater mussel *(Unio)*; while the flora comprises several genera and species of ferns, and representatives of cycadaceous and coniferous vegetation. The deposits were, therefore, probably formed in a large lake basin, or several smaller ones. This lake

may have been bounded in part by steep cliffs composed of Carboniferous glacial beds, and the climate may have been a rigorous one in winter. By assuming the operation of blown sand under strong winds the conditions would be present for the polishing of any pebbles disintegrated from the subjacent glacial beds. Continued action of blown sand on these pebbles would soon result in them acquiring their high polish. Now, if singly, or in numbers, they fell over the cliffs during the winter, on to the frozen surface of the lake, nothing remained but the floating away of the burdened ice when the thaw set in, and the subsequent dispersion of the transported pebbles among the sand of the lake bed as the ice of the floes melted away; or again, the pebbles may have fallen over the cliffs into shallow water, been frozen into ground ice, subsequently floated off, and finally dropped when the ice melted. These polished pebbles are found in many parts of the Jurassic system of South Gippsland. Few, however, have such a high polish as have those at Anderson's Inlet. This fact admits of the readier acceptance of the theory, since, assuming ground ice to have been the means of transport, the whole of the pebbles could hardly have been floated away quickly enough after their fall into the waters of the lake to have prevented their polish from being destroyed, either partially or wholly, by abrasion among the shingle and pebbles of the shore.

The absence of angular pieces of rock from among these polished pebbles can be explained by the reasonable assumption that the cliffs were composed wholly of glacial deposits, and as such they would contain comparatively few small angular pieces.

Again, the ice transport theory would probably explain the fracturing of the pebbles since they would thus have been subjected to great variations of temperature. The occurrence of so many of these fractured pebbles among the Jurassic sediments, as well as in the volcanic necks, is a striking feature. Had they been confined to the necks their fracturing could easily have been accounted for by violent contact with the material in the old volcanoes.

A consideration of these matters makes it seem not improbable that both of these agencies—driftwood and floating ice—have operated in the transport of these included pebbles in the Jurassics. It seems, besides, by no means improbable, that contem-

poraneous glacial action may account for some of the features noticeable among the sediments of this system. Not the least striking is the peculiar bluish and olive colour of the great majority of the mudstones. These have an exceedingly strong resemblance to the clay of the typical glacial deposits of Bacchus Marsh, Victoria, and Wynyard, Tasmania. The derivation of their mud from glacial streams discharging into the Jurassic lake is, therefore, not improbable.

Origin of Included Pebbles in Volcanic Necks.

The origin of the included pebbles in the necks is of interest. Two probable sources may be suggested:—

1. From among the Jurassic sediments, dispersed principally through the sandstones.
2. From a bed of conglomerate in the Jurassic system, or in some system underlying this one.

In view of the occurrence of the solitary pebbles among the local Jurassic strata, the former origin seems the more probable.

With reference to the latter it may be stated that nowhere in the visible Jurassic strata of the district is there any bed of conglomerate having polished pebbles; neither is there, with the exception of the conglomerates at San Remo, which occur at sea level, and may perhaps be the basal beds of the series, any deposit extensive enough to be called a bed of conglomerate. Besides, these San Remo conglomerates are composed of rocks entirely different from those under consideration, and the pebbles are not polished. The probability of the derivation of these pebbles, therefore, from a Jurassic bed of conglomerate is remote.

Then, as regards their possible derivation from a subjacent conglomerate of pre-Jurassic age, there does not appear to be any evidence in support. On the other hand, the absence of fragments of unpolished rocks, except those of Jurassic strata, practically prove that such was not their origin, since it is hardly likely that fragments of the rocks of other beds of the series would not have been included among the volcanic material had the pebbles been derived from such a source.

The pebbles in the necks have the same general shape as those among the Jurassics, and are broken in a similar way. They have

in several cases even the characteristic polish, though it is not so high as that of those in the Jurassics, and also the peculiar and numerous small semi-circular and circular fractures without separation, so common among some of these pebbles, and also of those among the glacial deposits of Victoria. One may be specially mentioned as it is of silicified wood, similar to that from the sediments, and possesses a considerable polish. It is, therefore, of particular interest, and assists materially in supporting the opinion held.

It is but to be expected that polished stones subjected to the treatment meted out to the constituents of agglomerates and tuffs would soon lose their polish through the attrition caused by the volcanic and other material. There is, however, one difficulty in the way of unreservedly accepting this mode of origin. This is the fact that the visible ash contains comparatively little fine quartz sand, such as would be expected to be found in it, were similar sandstones to those forming Jurassic sediments absorbed by a volcano, subsequently pulverised and mixed up, and finally allowed to settle. It is perhaps probable, however, that the bulk of the visible material derived from the Jurassics may have been obtained from the mudstone beds of the system.

General Remarks.

As far as I am aware, these Anderson's Inlet necks are the first of their kind, *i.e.*, those composed of clastic volcanic materials, to be described in Victoria. Messrs. T. S. Hall, M.A., and G. B. Pritchard, have described[1] certain clastic volcanic rocks at Curlewis, near Geelong, as a spot close to a vent of the Older Volcanoes, while Mr. Hall has further recorded[2] two volcanic necks of basalt at Mount Consultation and Diamond Hill, Castlemaine.

In New South Wales, in the neighbourhood of Sydney, at the prismatic sandstone quarry in the cliffs at Bondi, there is an occurrence of volcanic material, which has been briefly described[3] by Professor David, B.A., F.R.S.

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1 Notes on the Eocene Strata of the Bellarine Peninsula, with brief reference to other deposits. Proc. Roy. Soc. Vic., vol. vi. (n.s.), 1894, p. 3.

2 The Geology of Castlemaine, with a sub-division of the Lower Silurian Rocks of Victoria, and a list of Minerals. Proc. Roy. Soc. Vic., vol. vii. (N.S.), 1895, p. 81.

3 Notes on Some Points of Basalt Eruption in New South Wales. Trans. Geol. Soc. Aust., vol. i., pt. 1, p. 25. Melbourne, 1886.

Several much finer examples of necks have since been discovered in the neighbourhood of Sydney. References to occurrences in New South Wales are appended.[1]

The accompanying geological map of portion of South Gippsland is based upon the new Geological Map of Victoria. Such additional information as has been obtained since the completion of that map, has been added in a general way. The whole of the Waratah Bay area has been retained as Silurian, since undoubted Silurian limestones occur there. Mr. Stirling speaks[2] of some of the rocks in it as pre-Silurian and Cambrian, while Professor Gregory, D.Sc., F.R.S., Director of the Geological Survey of Victoria, has suggested[3] the probability of the occurrence there of an outcrop of pre-Ordovician rocks.

The period to which the granite of Yanakie, Wilson's Promontory, and Cape Woolamai belongs has not yet been definitely ascertained, though generally regarded as Devonian.

The geological map of the locality at Townsend Bluff, Anderson's Inlet, has been prepared from field notes obtained by a careful survey made with a prismatic compass and by pacing. The heights are aneroid measurements. The two sections across the necks are added to simply illustrate their character.

I am much indebted to Mr. E. F. Pittman, A.R.S.M., Government Geologist of New South Wales, for references to the Volcanic Necks literature, to Mr. A. Cuttriss and his two sons for the kindly help they have given me in various ways while the examination of the locality was being carried out, and to Mr. A. Elms, who accompanied and assisted me during one of my visits there.

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1 David, Professor T. W. E., Smeeth, W. F., Watt, J. A.: Preliminary Note on the Occurrence of a Chromite-bearing Rock in the Basalt at the Pennant Hills Quarry, near Parramatta. Jour. Roy. Soc. N.S.W., vol. xxvii., 1893.

Clarke, W. B.: On the Transmutation of Rocks in Australia. Trans. Phil. Soc. Aus., 1862-65, pp. 267-368.

Clarke, W. B.: The Sedimentary Formations of New South Wales, 4th ed., 1878, p. 72.

Wilkinson, C. S.: Ann. Rep. Dept. Mines, New South Wales, for 1879, p. 218.

Wilkinson, C. S.: Geology, in Handbook Aus. Assoc. Adv. Sci., Sydney Meeting, p. 34.

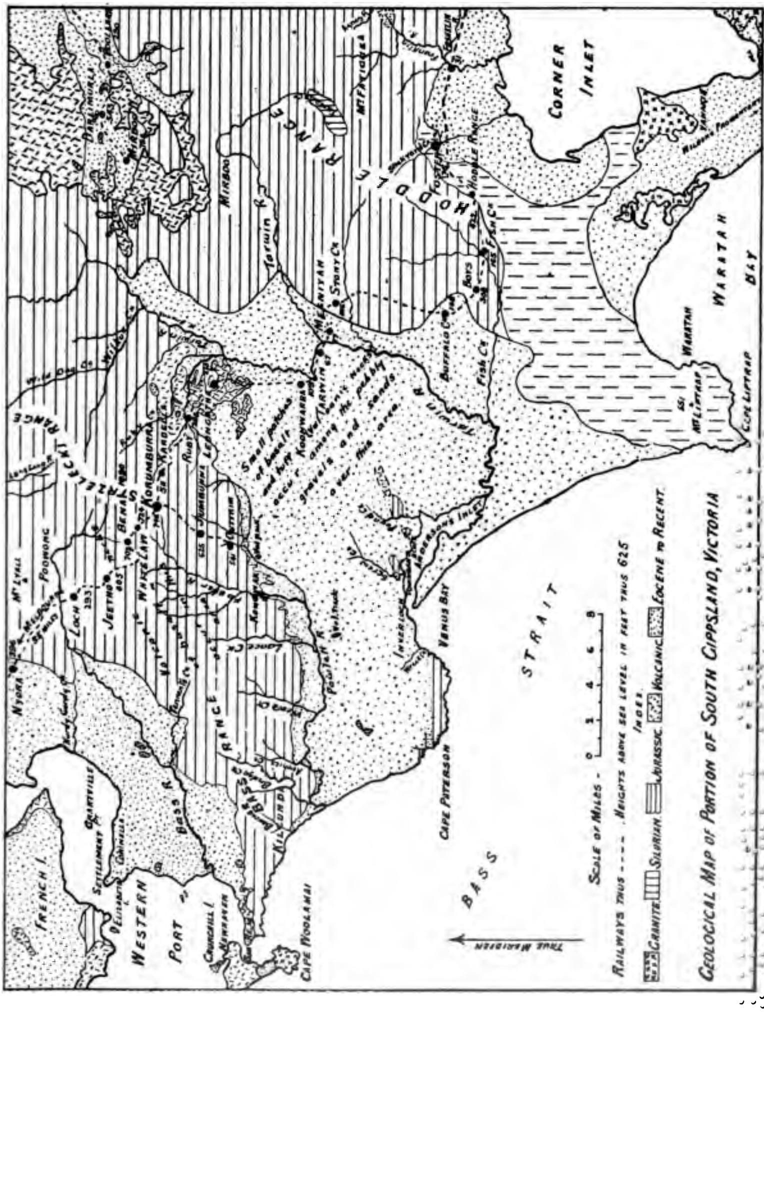
Curran, J. M.: Geology of Sydney.

Pittman, E. F.: The Mineral Resources of New South Wales, Sydney, 1901, pp. 393-4.

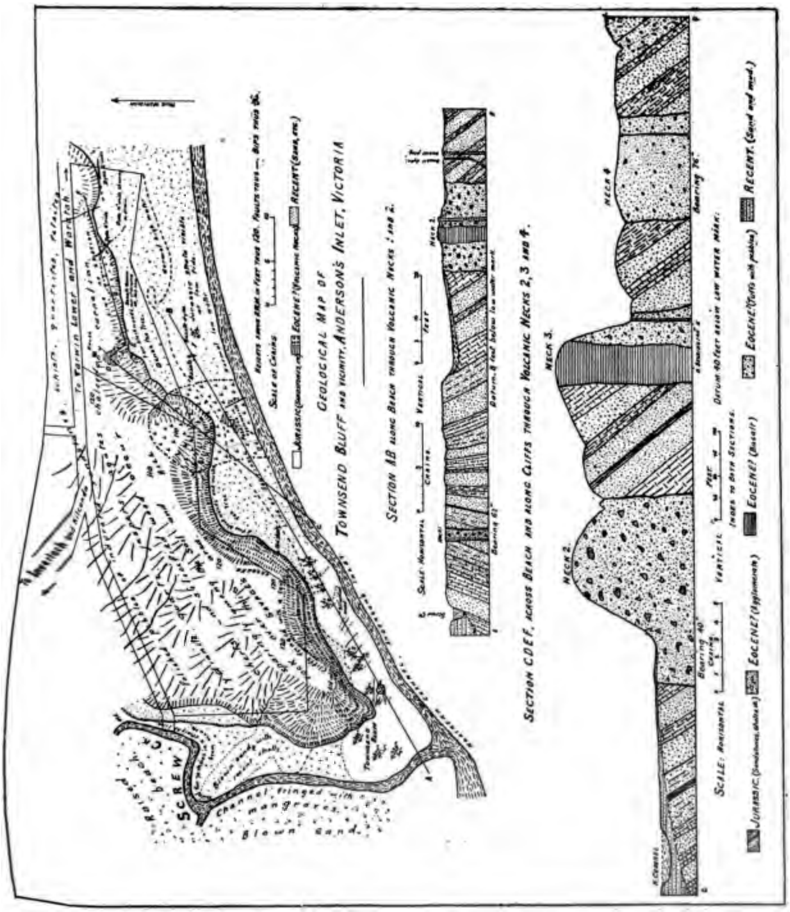
Carne, J. E.: The Kerosene Shale Deposits of New South Wales, 1903, p. 240.

2 *Op. cit.*

3 The Heathcotian, a pre-Ordovician Series—and its distribution in Victoria. Proc. Roy. Soc. Vic., vol. xv. (n.s.), pt. ii., 1903, pp. 167, 173.



GEOLOGICAL MAP OF PORTION OF SOUTH GIPPSLAND, VICTORIA


Geological Map of
Townsend Bluff and vicinity, Andersons Inlet, Victoria
Section AB along beach through volcanic necks 1 and 2.
Section CDEF, across beach and along cliffs through volcanic necks 2, 3 and 4.
Neck 2.
Neck 3.
Neck 4
Screw Ck
Blown sand.
Channel fringed with mangroves.

Art. XII.—*Some Features in the Geography of North-Western Tasmania.*

By J. W. GREGORY, D.Sc., F.R.S.,

Professor of Geology in the University of Melbourne.

[With Plates XX., XXI.].

(Read 9th July, 1903.)

The recent earth movements in Tasmania are of special interest to Victorian geologists, as they were probably connected with the formation of Bass Strait, a problem of primary importance in the geology of the Victorian coastlands.

In a recent visit to north-western Tasmania my first impression was of surprise, at seeing such clear evidence of an uplift (or to use Suess's more precise term, a negative movement), of that country to the height of several hundred feet. The railway from Emu Bay to Zeehan, on leaving the coast, started at once to climb a long slope, which proves to be the northern face of an undulating plateau. On reaching the plateau at Hampshire Plains, 20 miles from Burnie (altitude 1500 feet)[1] there is a fine view, southward and westward, to some bold peaks that rise abruptly above the general level of the country, like rocky islands above the sea. The traverse across the north-western corner of Tasmania to Macquarie Harbour enabled me to see many of the features of this plateau, and to recognise it as a member of that class of land forms which Professor W. M. Davis calls an uplifted pene-plain. The surface of this pene-plain is in places, as near Farrell and the foot of the West Coast Range, 1300 feet or more above the sea; but it becomes lower to the north, west and south. This pene-plain area extended, as far as I could see, from the Emu Bay Railway towards the northern and north-western coast. Inland it ends abruptly against the West

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1 For the altitude and for facilities in examining this country, I am indebted to Mr. J. Stirling, the Manager of the Emu Bay Railway.

Coast Range, at a distance of from 20 to 25 miles from the sea. It extends in a broad band parallel to the western coast, at least from the Arthur River on the north, to some distance south of Macquarie Harbour, where it apparently sinks to but little above sea level.

The general contour of the country between Emu Bay and Strahan shows that the pene-plain in this part of Tasmania was due to river action, and that the main slope is downward to the west; but subsequent river action has destroyed so much of the surface of the plain that its existence can only be recognised in a broad distant view.

The best views showing the geographical structure of the country are gained looking westward from the peaks of the West Coast Range, as from the western end of the ridges of either Mount Sedgwick or Lyell (Figs. 2 and 3). The view from the summit of the Haulage of the Mount Lyell Mining and Railway Company is less extensive; but it shows the features of the pene-plain of the Henty and Queen rivers exceptionally well. At the foot of the steep ridge of schists is the deep valley of the Queen River; beyond it, the country looks rugged and irregular, consisting of a series of deep gullies and river valleys separated by narrow spurs and ridges. Here and there is an expanse of open plateau, such as Madam Howard's Plains, relics of the widespread plain that existed before the country was dissected into the present maze of ridge and gorge. The crests of the ridges generally reach to the level of the old pene-plain surface; and further to the west, as the details become obscured in the distance, the valleys are hidden and the blue hills and ridges combine to give the impression of a level plain, sloping slightly toward the sea. In the far distance the edge of the pene-plain forms a skyline almost as straight, and horizontal, and featureless as that of the sea beyond. To the north and south, the level of the land is less regular, for the country slopes upward to the hills that mark the site of the banks of the old river, which made this part of the pene-plain; and further northward the truncated cone of Mount Zeehan, the long serrated crest of the Heemskirk Range, and the tumbled masses of the West Coast Range, rise high above the general level of the country.

The upper, or eastern part of this pene-plain, is comparatively narrow. It is bounded on the south by some woody hills, which run northward from the King River, and on the north by Crown Hill and the mountain known as the Professor. These hills must, at one time, have formed the banks of the river which eroded this part of the pene-plain. This river rose on the Central Plateau, near the Eldon Range, and flowed first through the upper part of the valley of the King River, and then along the Sedgwick Valley and through the gap between Mounts Sedgwick and Lyell, over the site of the Queen River valley. As the river flowed westward its valley became wider. It was joined by tributaries from the south, which drained country now included in the lower basin of the King River; it was also joined by the Henty and other rivers from the north. As most of this area is now drained by the Henty, I suggest for it the name of tne Henty pene-plain. Near the sea this pene-plain joins with those of other rivers, and they together form the continuous pene-plain which backs the western coast of Tasmania.

The eastern part of the Henty pene-plain, between the lower King River and the Professor, has the features of the lower valley of a large river. This aspect of the country is especially well seen from Mount Lyell. The slopes on either side have the contours characteristic of the sides of an old river valley, and not of cliffs formed by marine denudation. If the pene-plain had been formed by the sea, some remains of old cliffs and beaches might be expected to occur round it, and some traces of marine deposits on its floor. I am not aware that any such have been found or recorded, while I am told by Mr. Huntley Clarke, Engineer of Supplies at Mount Lyell, that some of the hills are capped by river gravels.

Montgomery has described the occurrence of rounded, waterworn gravel upon this pene-plain, and has described the area as a plain of marine erosion.[1] He says, "At the Nine Mile Plain on the road from Strahan, a good deal of well-rounded waterworn gravel is seen lying on the bed-rock beneath the surface soil, at an elevation of from 700 to 800 feet above sea level, and pretty well on the top of a watershed."

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1 A. Montgomery: "Notes on the Queen River and Mount Lyell Mining District," Parl. Pap., Tasmania, 9th July, 1894.

… River itself appears too small to have formed so …; but it is clear that the river system in this part …asmania, at no distant date, was arranged very differently …ts present plan.

Between Mount Lyell and Mount Sedgwick in the north there is a deep valley. It is known as the Sedgwick Valley, and is two miles in breadth. Though the walls on both sides are steep, they have been cut back into deep gullies, between which are long rocky spurs, so that the Sedgwick Valley shows signs of much greater age than the canyon of the King River. This Sedgwick Valley is a direct continuation of the north-eastern branch of the King River, which drains the southern slope of the Eldon Range. The valley to the Henty pene-plain opens by a low pass known as the Sedgwick Gap. This Gap, now 1160 feet above sea level, is but slightly raised above the King River, at its bend to the east of the Gap. In all probability the King River once continued its westward course along the Sedgwick Valley, through the Gap, and across the site of the Henty pene-plain to the south of Crown Hill and the Professor. This river would have been of considerable size and quite sufficient to have formed the pene-plain. Then, either the glacier which formerly filled the valleys of the King River and some of its tributaries, or a slight uplift along the Great Fault of Mount Lyell—which runs along the western face of Mounts Sedgwick, Lyell and Owen—interrupted the course of the King River. The river was dammed back till it found a fresh outlet to the south of Mount Owen, through the gap between Mounts Huxley and Jukes. There it has cut for itself the deep canyon, through which it flows to Macquarie Harbour.

One important point in connection with the age of the pene-plain and the deflection of the King River is its bearing on the age of the recent glacial deposits of Tasmania. It has often been maintained that extensive glaciations are the result of increased elevation; and this explanation is attractively simple because, if a country be uplifted, its temperature must be reduced; and, therefore, if the precipitation remain the same, its snowfall will be increased. The explanation, however, does not appear to be consistent with the facts in some cases, where there is a considerable amount of evidence as to the relations of maximum glacia-

tion and earth movements.[1] Nor is there any evidence, as far as I am aware, that Tasmania has been uplifted, in Cainozoic times, much above its present level.[2] It is indeed possible, as maintained by Montgomery, that the glacial deposits of Tasmania were formed when the country stood some hundreds of feet below its present level. The western glaciers followed the existing valleys, occupying those between Mount Sedgwick and Mount Tyndall, between Mount Sedgwick and Mount Lyell, and down the King River to the east of Mounts Lyell and Owen. The course of these valleys had been determined by earth movements in pre-glacial times; and the general evidence renders it highly improbable that they were scooped out by glacial action, although the glaciers may have deepened and modified them. Hence the diversion of the King River from its old course through the Sedgwick Valley, to its present circuitous route to the south of Mount Jukes, was probably caused during the latter part of the glacial period. The damming up of the Sedgwick Valley by ice and moraines was quite sufficient to cause the drainage from the glaciers in the Upper King Valley to overflow at the lowest gap on the southern margin of the King basin; and the lowest available outlet was between Mount Huxley and Mount Jukes.

The glacial deposits around Mount Lyell are more recent than the formation of the Henty pene-plain, for that plain was made by a pre-glacial river, and some glacial deposits occur in valleys cut through it, as at Queenstown; but the difference in time was probably small. The pene-plain was certainly formed when western Tasmania stood a few hundred feet lower than it does now; and Montgomery may be correct in his view that the glaciation of Tasmania occurred in this period of depression.[3] Mr. R. M. Johnston does not favour the idea of any considerable earth movements in Tasmania in recent geological times. He says,[4] "In Tasmania there is little evidence of physical disturb-

1 See for example, "Contributions to the Glacial Geology of Spitzbergen," Quart. Journ. Geol. Soc., vol. liv., 1898, p. 224.

2 The drowned valleys of the Tamar and the Derwent do not necessarily indicate a subsidence of the whole of Tasmania.

3 Montgomery, A.: "Glacial Action in Tasmania." Proc. Roy. Soc. Tas, 1893 (1894), p. 165.

4 Johnston, R. M.: "Geology of Tasmania," p. 326.

ances of an extraordinary character during the [Post Tertiary] period, if we except the minor local oscillations of land indicated by the raised beaches on the islands of Bass Strait, and on other places along the northern coastline of Tasmania. . . . . It may generally be affirmed that the leading features—the mountain chains and ridges, the main valleys and their river courses, the great plains and plateaux—were all established prior to the deposit of the members of the Post Tertiary age." The Henty pene-plain, however, has been so deeply dissected that it is probably somewhat older than the glacial deposits, which in some cases are comparatively fresh.

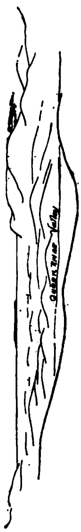
The formation of the Henty pene-plain must have been a long task, and must have been completed when Tasmania was less elevated than it is now. It may have been contemporary with the formation of the extensive dissected pene-plains, which are among the most important features in the geography of Victoria.

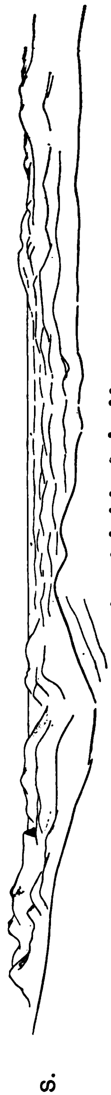
The date at which the pene-plain was uplifted is, though preglacial, geologically recent. The most convincing evidence is given by the narrowness of the river gorges that cut through it. The railway between Emu Bay and Strahan runs for some distance down the Pieman Valley, a deep and narrow gorge, the bed of which is being rapidly deepened by corrosion. The Henty River near Strahan flows across a low-lying alluvial plain, crossed by lines of high, weathered, sand dunes; but further to the east this river cuts through the pene-plain in a very deep gorge.

The best case, however, is that of the King River, which rises in the central plateau of Tasmania. East of Mount Lyell it flows through a broad, flat-floored valley, known as the "Long Marsh." Here its valley is obviously of great age, but further down its course the river flows through a sinuous, narrow canyon. Mr. W. T. Batchelor, the engineer of the Mount Lyell Mine, kindly told me that in one place the depth is 1700 feet, where the canyon is at the summit only between 2000 and 2500 feet across. The narrowness of this river gorge, and the vertical character of its cliffs, show that it is a very young valley.

Further evidence indicating a comparatively recent uplift of this part of Tasmania is supplied by the southern face of Mount Sorell. This mountain is situated on the northern side of Macquarie Harbour. It consists of a block of the West Coast Range

- - - - - - Former course of the King River through the Sedgwick Gap into the Henty River.


N.
Crown Hill.
The Professor.
Cliffs, Canyon of Henty.
Sea seen across
Henty Pene-Plain.
Hills S. of Queen River.
S.


N.
Heemskirk Ranges.
The Professor.
Sea seen across
Henty Pene-Plain.
Queen River Gorge.
N. continuation of
Gentle Annie.
King River Gorge.
Gentle Annie.
S.

conglomerates resting upon Lower Palaeozoic or Archean beds. A straight, well-marked beach line runs across the southern face of the mountain. Its level is quite straight, though it is now tilted slightly from the horizontal, dipping at about 5 degrees to the west. The terrace, so far as could be seen from the steamer, cuts across the bedding of the strata, so that it cannot be due to the outcrop of a band of hard rock. It is clearly a beach line formed when the country stood several hundred feet lower than at present.

DESCRIPTION OF PLATES.

1. Sketch map of north-western Tasmania, showing parts of the areas occupied by the Central Plateau, and by the North-Western, Henty and Western Pene-Plains; and the probable former course of the Henty and King Rivers. The Central Plateau is accepted from the map in Johnston's Geology of Tasmania. The boundaries of the pene-plains are approximate, and the limits uncertain.
2. Sketch of the view across the Henty Pene-Plain from the hill face above the Royal Tharsis Mine, Mount Lyell.
3. Outline sketch across the Henty Pene-plain from the western spur of Mount Lyell.

Figures 2 and 3 have been drawn by Mr. D. J. Mahoney, from sketches by the author.

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CONTENTS OF VOLUME XVI., PT. II.

Art. XIII.—*On some Foraminifera and Ostracoda from Jurassic (Lower Oolite) Strata, near Geraldton, Western Australia.*

By FREDERICK CHAPMAN, A.L.S., F.R.M.S.,

National Museum.

(With Plates XXII., XXIII.).

[Read 13th August, 1903].

Introductory Remarks.

During an inspection of a series of fossils collected in Western Australia for the Hon. (then Mr.) A. C. Gregory, F.R.G.S., and sent by Mr. R. Daintree, F.G.S., to Professor McCoy, at the National Museum, Melbourne, I noticed that the calcareous and sandy infilling of specimens of Cucullaea and Trigonia was so friable and promising for microzoa, as to justify a careful search through the material after it had been broken down and washed. The result was very gratifying, as some entirely new Ostracoda were found; whilst the Foraminifera were represented by an interesting series of twenty-three species, some of which are also new, and those already known throw a certain light on the affinity of these beds with others containing similar microzoic faunas elsewhere.

The only earlier record of jurassic Foraminifera which I can find is that of Cristellaria cultrata, Montfort sp., given by Charles Moore[1] in his list of West Australian fossils, but unaccompanied by any reference as to its locality. The evidence of the context in that paper respecting the localities of the mesozoic fossil collections in Moore's hands, points in favour either of the district of Shark's Bay or of Champion Bay.

As regards later mesozoic microzoa, nine species of Foraminifera and an entomostracan have been recorded from Wollumbilla,

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1 Quart. Journ. Geol. Soc., vol. xxvi., 1870, p. 231.

Queensland, by Charles Moore,[1] who was himself uncertain as to the age of these beds, but made the suggestion that they belonged to strata between the lias and cretaceous, and showing most affinity to the Oxford clay. These Queensland beds have now been correlated with the lower cretaceous formation, as part of the Rolling Downs series.

Whilst referring to upper mesozoic Foraminifera in Australia, mention must also be made of the important and interesting series, comprising fifty-six species, discovered by the Rev. W. Howchin, F.G.S., in the material from artesian well-borings in the lower cretaceous of Central Australia.[2]

Our present series of Foraminifera has several species in common with Howchin's list, but they are also common to beds ranging from upper jurassic to lower cretaceous elsewhere, and other species comparable even with those of recent origin.

As regards the Ostracoda there appears to be no previous record for these fossils in Australian jurassic strata.

DESCRIPTION OF THE FOSSILS.

Order FORAMINIFERA.

Family *Lituolidae.*

Sub-family *Lituolinae.*

Genus *Haplophragmium*, Reuss.

Haplophragmium neocomianum, Chapman. (Pl. XXII., Fig. 1).

H. neocomianum, Chapman, 1894, Quart. Journ. Geol. Soc., vol. l., p. 695, pl. 34, figs. 2*a*, *b*.

Idem, 1895, Ann. Mag. Nat. Hist., ser. 6, vol. xvi., p. 315, pl. xi., fig. 7.

Remarks.—This is a compressed, spiral, arenaceous form, having an irregular, sub-circular outline. The whorls of the test are involute, and the chambers are obscurely seen on the surface;

1 *Tom. cit.*, p. 239; also R. Etheridge, Junr., "A Catalogue of Australian Fossils," Cambridge, 1878, pp. 102-4.

2 Trans. Roy. Soc. S.A., vol. viii., 1885, p. 79; vol. xvii., 1893, p. 346; Rep. Adelaide Meeting, A.A.A.S., 1893 (1894), pp. 362-5.

but the latter are made apparent by moistening the test. This species is a frequent concomitant of mesozoic microzoa, and has been found in the rhaetic of Somerset, and the neocomian of Dorking, England; also in the cretaceous of South Africa (author's MS.).

Occurrence.—One specimen of medium size, jurassic, Greenough River district, West Australia. [2121.]

Family *Textulariidae.*

Sub-family *Textulariinae.*

Genus *Textularia*, Defrance.

Textularia crater, sp. nov. (Pl. XXII., Figs. 2 and 2*a*).

Specific characters.—Test very short, laterally slightly compressed, and, therefore, sub-elliptical in cross-section. Aboral end rounded. Oral surface depressed, the apertural margin limbate. The margin of the last and penultimate chambers somewhat square with the upper surface of the test. Chambers few, obscurely seen on the surface of the shell, but the textularian arrangement may be made out without much difficulty. Texture finely arenaceous. Length of test, 0.14 mm. Greatest width, 0.3 mm.

Affinities.—The short textularians with more or less limbate sutures and apertural margin fall into the groups of T. trochus, D'Orb., and T. conica, D'Orb.; according to their circular or sub-elliptical outline in cross-section. Our specimen naturally falls into the latter group, but may be distinguished from typical forms of T. conica, by its rounded basin-shaped test and strongly concave oral surface.

Occurrence.—One specimen; Greenough River district, West Australia. [2122.]

Sub-family *Bulimininae.*

Genus *Bulimina*, D'Orbigny.

Bulimina gregorii, sp. nov. (Pl. XXII., Figs. 3 and 3*a*).

Specific characters.—Test sub-rhomboidal, compressed, with rounded lateral edges. Aboral end terminated by a blunt spike.

Aperture typically bulimine. Sutures faintly marked; chambers not very numerous. Shell-texture finely arenaceous. Length, 0.22 mm., greatest width, 0.13 mm.

Affinities.—The form of the test and comparative fewness of the chambers remind one of Bulimina pyrula, D'Orb.[1] Our species, however, is readily distinguished from that form by the strong compression of the test. The two speciés B. caudigera, D'Orb.,[2] and B. ovula, D'Orb.,[3] also bear some relationship to our form, both in the compression of the test, and in having an aboral spine. The compression in our species is so marked, amounting to a concavity of the external surface, that it will be as well to regard it as a distinct form. It is worth noting that B. pyrula, D'Orb., occurs in certain jurassic clays in England, as recorded by Messrs. Jones and Parker ("triassic" clay of Chellaston).[4]

The above species is named after the of Hon. A. C. Gregory, F.R.G.S., under whose auspices the larger fossils were collected, and who gave them to Mr. Daintree.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2123.]

Family *Lagenidae.*

Sub-family *Nodosariinae.*

Genus *Marginulina*, D'Orbigny.

Marginulina compressa, D'Orbigny, (Pl. XXII., Fig. 4).

M. compressa, D'Orb., 1840, Mém. Soc. Géol. France, vol. iv., p. 17, pl. i., figs. 18, 19.

Reuss, 1845, Verstein. böhm. Kreidef., pt. i., p. 29, pl. xiii., fig. 33.

Chapman, 1894, Quart. Journ. Geol. Soc., vol. l., p. 709.

Remarks.—The genera Marginulina and Vaginulina insensibly graduate into one another, exemplified in certain forms of the

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1 D'Orbigny, 1846, For. Foss. Vienne, p. 184, pl. xi., figs. 9, 10.

2 D'Orbigny, 1826, Ann. Sci. Nat., vol. vii., p. 270, No. 16——, Modèle, No. 68.

3 D'Orbigny, 1839, Foram. Amér. Mérid., p. 51, pl. i., figs. 10, 11.

4 Jones, T. R., and Parker, W. K.: Quart. Journ. Geol. Soc., vol. xvi., 1860, pp. 453, 454, and 457, pl. xx., fig. 45.

present type, the marginuline species becoming vaginuline by the continued compression of the test. Our specimen seems to occupy a place midway between these genera, but since it agrees with the original figure of Marginulina compressa given by D'Orbigny, rather than with the flatter type, Vaginulina legumen, Linné sp., it may be conveniently retained in the former genus. M. compressa has been previously found in the neocomian pebble beds of Littleton, near Guildford, England (Chapman); the greensand of Le Mans, and the chalk of Meudon, France (D'Orbigny); the chalk of Charing, Kent, England (Jones in Morris's Catalogue); and the chalk of Bohemia (Reuss).

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2124.]

Marginulina solida, Terquem. (Pl. XXII., Fig. 17).

Marginulina hybrida, Zwingli and Kübler (non Terquem), 1870, Foraminif. Schweiz. Jura, p. 27, pl. iii., fig. 25.

M. solida, Terquem, 1886, Mém. Soc. Géol. France, ser. 3, vol. iv., Mém. ii., p. 24, pl. ii., figs. 34 to 43 (*cf.*, fig. 40).

M. cf. *solida*, Terquem, Wisniowski, 1890, Pamietnik wydz matem.—przyrodn. Akad. Umiejetn. w. Krakowie, vol. xvii., p. 26, pl. viii. (i.), fig. 59.

Remarks.—The Australian specimen evidently belongs to this species, which, although variable, shows certain features which enable one to place it in the group with Marginulina glabra, D'Orb., for a central type; this particular form being altogether slenderer and more compressed than the species just mentioned.

The specimens to which references are made above came from the upper jurassic beds of Poland and Switzerland.

Comparison may also be made with the M. pauciloculata of Hantken,[1] from the eocene of Hungary, which is also a compressed few-chambered form of the type of M. glabra.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2125.]

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1 Mitth. a. d. Jahrb. k. ungar. Geol. Anstalt, vol. iv., 1875 (1881), p. 47, pl. xiv., figs. 10*a*, *b*.

Genus *Vaginulina*, D'Orbigny.

Vaginulina schloenbachi, Reuss, *var.* **interrupta**, nov. (Pl. XXII., Fig. 5).

This variety is distinct from the specific form V. schloenbachi[1] in having the long curved costae interrupted in the posterior area of each chamber. The costae themselves are also more numerous, averaging six in each series in the variety, against three in the type form. The original species came from the neocomian beds of North Germany.

Occurrence.—One specimen of this variety was found in the jurassic of the Greenough River district, West Australia. [2126.]

Vaginulina lata, Cornuel sp. (Pl. XXII., Fig. 6.)

Marginulina lata, Cornuel, 1848. Mém. Soc. Géol. France, ser. 2, vol. iii., p. 252, pl. 1, figs. 34-7.

Planularia pauperata, Jones and Parker, 1860. Quart. Journ. Geol. Soc., vol. xvi., p. 454, pl. xx., fig. 39.

Cristellaria simplex, Terquem, 1863. Foram. du Lias, troisième Mém., p. 203, pl. ix., fig. 15.

Planularia pauperata, Jones, Parker, and Brady, 1867. Proc. Somerset Arch. and Nat. Hist. Soc., vol. xiii., p. 110, pl. ii., figs. 24, 25.

Cristellaria pauperata, (Jones and Parker) Blake, 1876. The Yorkshire Lias, p. 465, pl. xix., fig. 12.

C. lata (Cornuel), Brady, 1884. Rep. Chall., vol. ix., p. 539, pl. lxvii., figs. 18*a*, *b*.

C. lata (Cornuel), Crick and Sherborn, 1891. Journ. North N. H. Soc., vol. vi., p. 213, pl. —., fig. 32.

Remarks.—These compressed *quasi* cristellarian forms appear more properly to belong to the genus Vaginulina, as it is now understood, since the present type of shell has no distinct spiral commencement, and the test is uniformly flattened. The few-chambered, broad, compressed shells which may be referred to

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1 Reuss, 1862 (1863), Sitzungsb, d. k. Ak. Wiss. Wien., vol. xlv., Abth. 1, p. 46, pl. iii., figs. 6*a*, *b*.

the above species are mostly characteristic of mesozoic strata; but the species has also been recorded from recent soundings off Moncoeur Island, Bass Strait, at a depth of 38 fathoms.

Our specimen somewhat resembles a closely allied form which was found in the gault of France and England, Vaginulina biochei, Berthelin.[1] The latter form, however, is distinguished by the thickened sutures of the chambers having a tendency to become salient, especially on the inner (anti-stoloniferous) margin of the test.

Occurrence.—One specimen (small); jurassic, Greenough River district, W. Australia. [2127].

Vaginulina strigillata, Reuss. (Plate XXII., Fig. 7).

Vaginulina (*Citharina*) *strigillata*, Reuss, 1846. Verstein böhm. Kreidef., pt. ii., p. 106, pl. xxiv., fig. 29.

V. strigillata, Reuss, Jones, and Parker, 1860. Quart. Journ. Geol. Soc., vol. xvi., pp. 453, 457, pl. xx., figs. 30-35.

V. strigillata, Reuss, Wisniowski, 1890. Pamietnik wydz matem.—przyrodn. Akad. Umiejetn w. Krakowie, vol. xvii., p. 29, pl. ix. (ii.), fig. 5.

V. strigillata, Reuss, Chapman, 1894. Journ. R. Micr. Soc., p. 432, pl. viii., figs. 3*a*, *b*, and 4.

Remarks.—The striate Vaginulinae are of very frequent occurrence in mesozoic strata, and are fairly common throughout the whole of the jurassic and cretaceous strata.

The particular form under notice is distinguished from others closely allied by the more pronounced striations on the surface of the shell, and which bridge over the suture lines, the latter being more or less depressed.

Occurrence.—One specimen (fragmentary); jurassic, Greenough River district, West Australia. [2128.]

Vaginulina intumescens, Reuss. (Pl. XXII., Fig. 8).

Vaginulina intumescens, Reuss, 1862 (1863). Sitzungsb. d. k. Ak. Wiss. Wien, vol. xlvi., Abth. 1, p. 49, pl. iv., fig. 2.

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[1] Mém. Soc. Géol. France, ser. 3, vol. 1, No. 5, 1880, p. 42, pl. ii., figs. 9*a*, *b*. Also Chapman, Journ. R. Micr. Soc., 1894, p. 427, pl. viii., figs. 14*a*, *b*.

Marginulina scalprum, Terquem, 1866. Foram. du Lias, sixième Mém., p. 509, pl. xxi., fig. 27.

Remarks.—This species has, typically, a sub-triangular test, strongly compressed; ornamented with fine, curved, longitudinal striae. Terquem's liassic specimen has more numerous and narrower chambers than ours.

V. intumescens was originally obtained from the neocomian of Germany, and it has also been recently found in the cretaceous of South Africa. (Author's MS.)

Occurrence.—Frequent; jurassic, Greenough River district, West Australia. [2129-31.]

Genus *Cristellaria*, Larmarck.

Cristellaria rotulata, Lamarck sp. (Pl. XXII., Fig. 9.)

Lenticulites rotulata, Lamarck, 1804. Ann. Muséum, vol. v., p. 188, No. 3. Tab. Encycl. Méth., pl. ccccIxvi., fig. 5.

Cristellaria rotulata (Lam.), D'Orbigny, 1840. Mém. Soc. Géol. France, ser. 1, vol. iv., p. 26, pl. ii., figs. 15-18.

Rotulina muensteri, Römer, 1841. Verstein. norddeutsch. Kreidegeb., pt. 2, p. 98, pl. xv., fig. 30.

Cristellaria rotulata (Lam.), Reuss, 1846. Verstein. böhm. Kreidef., pt. 1, p. 24, pl. viii., figs. 50*a*, *b*, and 70.

C. muensteri (Röm.), Reuss, 1862 (1863). Sitzungsb. d. k. Ak. Wiss. Wien., vol. xlvi., Abth. 1, p. 77, pl. ix., figs. 3*a*, *b*, and 4*a*, *b*.

C. lenticulata, Wisniowski, 1890. Pamietnik wydz matem.—przyrodn. Akad. Umiejetn w. Krakowie, vol. xvii., p. 47, pl. ix. (ii.), figs. 24*a*, *b*.

C. rotulata (Lam.), Perner, 1892. Foraminifery Ceského cenomanu, p. 62, pl. iv., figs. 1-11.

C. rotulata (Lam.), Egger, 1899. Abhandl. K. bayer. Ak. Wiss., Cl. ii., vol. xxi., Abth. 1, p. 122, pl. xi., fig. 3.

Remarks.—This widely distributed and persistent type is a well-known form in jurassic deposits, but it is not nearly as common as the more ornate type with secondarily thickened sutures, exemplified by the Cristellaria cassis group.

Occurrence.—One specimen (small, but otherwise typical); jurassic, Greenough River district, West Australia. [2132].

Cristellaria subalata, Reuss. (Pl. XXII., Fig. 10.)

Cristellaria subalata, Reuss, 1854. Denkschr. k. Ak. Wiss. Wien., vol. vii., Abth. 1, p. 68, pl. xxv., fig. 13.

Robulina megalopolitana, Reuss, 1855. Zeitschr. d. deutsch. geol. Gesellsch., vol. vii., p. 272, pl. ix., figs. 5*a*, *b*.

Cristellaria subalata, Reuss, 1862 (1863). Sitzungsb. d. k. Ak. Wiss. Wien., vol. xlvi., p. 76, pl. viii., fig. 10; pl. ix., fig. 1.

C. subalata, Reuss, Chapman, 1896. Journ. R. Micr. Soc., p. 3, pl. 1, figs. 3*a*, *b*.

C. subalata, Reuss, Egger, 1899. Abhandl. k. bayer, Ak. Wiss., Cl. ii., vol. xxi., Abth. 1, p. 118, pl. xi., figs. 19, 20.

Remarks.—This species is also known from older tertiary strata, but is more commonly met with in the jurassic and lower cretaceous series. It has also been found recently in the cretaceous of South Africa. (Author's MS.).

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2133.]

Cristellaria prominula, Reuss. (Pl. XXII., Figs. 11, 11*a*).

Cristellaria prominula, Reuss, 1855, Zeitschr. d. Geol. Gesellsch., vol. vii., p. 271, pl. ix., figs. 3*a*. *b*.

C. prominula, Reuss, Chapman, 1894, Quart. Journ. Geol. Soc., vol. l., p. 714.

Remarks.—The distinctive features of this form are the prominence of the sutural lines which mark the junction of chambers, less strongly curved on the septal face than in the nearly allied C. subalata; and the greater height of the chambers when compared with the species just mentioned. C. prominula has been recorded from the lower and upper cretaceous of Europe.

Occurrence.—One specimen (small); jurassic, Greenough River district, West Australia. [2134].

Cristellaria decipiens, Wisniowski. (Pl. XXII., Fig. 12.

Cristellaria decipiens, Wisniowski, 1890. Pamietnik wydz matem.—przyrodn. Akad. Umiejetn. w. Krakowie, vol. xii., p. 42, pl. x. (iii.), figs. 5*a*, *b*, and 11*a*, *b*.

Remarks.—This ornate cristellarian belongs to the group of which C. cassis, Fichtel and Moll. sp., forms a central type.

The original specimens figured by Wisniowski, came from the upper jurassic (Am. ornatus beds) of Poland.

Occurrence.—One specimen; jurassic, Geenough River district, West Australia. [2135].

Cristellaria daintreei, sp. nov. (Pl. XXII., Fig. 13.

Specific characters.—Test ovate-elongate, compressed, nine chambers visible, those forming the spiral portion sparsely granulate to tuberculate. The sutural depressions of the last three chambers bridged over by about seven short longitudinal costae. The last chamber is somewhat inflated. Length 0.46 mm.; greatest width 0.2 mm.

Affinities.—The nearest analogue to this species is C. gemmata, Brady[1]. Both forms have a compressed test, but the ornamentation of C. daintreei differs essentially in the semi-costate surface markings of the last few chambers.

In the character of the ornament C. daintreei also resembles some extreme forms of C. fragraria, Gümbel sp. (= C. wetherelli, Jones sp.)[2] in which the test is strongly compressed, and the later chambers costate.

The present species is named in honour of the late Mr. Richard Daintree, F.G.S., who presented the larger fossils to the National Museum.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2136].

Cristellaria costata, Fichtel and Moll. sp., var. compressa, nov. (Pl. XXII., Fig. 14).

Ref. to type-form.—

Nautilus costatus, Fichtel and Moll., 1798, Test. Micr., p. 47, pl. iv., figs, *g*, *h*, and *i*.

Remarks.—The present variety, *compressa*, is a strongly compressed form. The spiral commencement is not well developed,

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1. Rep. Chall., vol. ix., 1884, p. 554, pl. lxxi., fig. 6, 7.

2 Abhandl. k. bayer. Ak. Wiss., m. p.h. Cl., vol. x., p. 635, pl. i., figs. 58*a*-*c*.

and in this, as in other features, such as the broad curvature of the septa, it closely approaches the vaginuline style of test. The longitudinal costae are fairly well developed, but are somewhat interrupted near the sutural depressions. Length of specimen 0.4 mm.; greatest width 0.3 mm.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2137].

Cristellaria costata, F. and M. sp., var. seminuda, nov. (Pl. XXII., Fig. 15).

Remarks.—This variety differs from the type in the interruption of the longitudinal costae on the central area of each chamber. The test is also more elongate, with fewer chambers, and is less inrolled than the type-form. The peripheral margin is bordered by a narrow keel.

Length of test, 0.38 mm.; width, 0.22 mm.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2138.]

Cristellaria *cf.* limata, Schwager. (Pl. XXII., Fig. 16).

Cristellaria limata, Schwager, 1868. Benecke's Geog. Pal. Beiträge, vol. i., p. 657, pl. xxxiv.

C. limata, Schwager, Wisniowski, 1890, Pamietnik wydz matem.—przyrodn. Akad. Umiejetn. w. Krakowie, vol. xvii., p. 34, pl. ix. (ii.), fig. 19.

Remarks.—The group of C. crepidula, Fichtel and Moll. sp., comprises many varieties or so-called species, but out of all the well-known examples figured none can be quoted as exactly matching the West Australian specimens. The nearest allied form is that figured by Schwager from the Ammonites (Sonninia) sowerbyi zone (middle brown jura, lower oolite) of Germany; and by Wisniowski from the Ammonites (Cosmoceras) ornatus zone (Middle Oolite) of Poland. The well-rounded outline of the back of the test seen in our specimens is also exemplified in C. limata, but the latter form is not so strongly compressed on the sides. Another form which may be noticed is C. opercula, Crick and Sherborn, from the upper lias of Moulton, Northampton,

England,[1] which is also comparatively thin and compressed; C. opercula differs, however, from the above form in the relative paucity of the chambers, and the more circular form of the test.

Occurrence.—Somewhat frequent; jurassic, Greenough River district, West Australia. [2139-41].

Genus *Flabellina* D'Orbigny.

Flabellina dilatata, Wisniowski. Pl. XXII., Fig. 18).

Flabellina dilatata, Wisniowski, 1890, Pamietnik wydz matem.—przyrodn. Akad. Umiejetn. w. Krakowie, vol. xvii., p. 50, pl. x. (iii..), 21.

Remarks.—This species reminds one of the F. rugosa,[2] from the Chalk of France, England and Bohemia, but it has the sutures practically flush with the surface of the test, whereas in F. rugosa they are salient.

Terquem's F. semi-involuta[3] is a similar form of shell, but it is not so roundly ovate, and the chevron-shaped segments of the later portion tend to overlap one another on the periphery. This species came from the jurassic (fuller's earth) series of Warsaw, Poland. F. dilatata was obtained from the "ornatus" beds of Poland.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2142].

Sub-family *Polymorphininae.*

Genus *Polymorphina*, D'Orbigny.

Polymorphina burdigalensis, D'Orbigny. (Pl. XXII., Fig. 19).

Polymorphina burdigalensis, D'Orbigny, 1826. Ann. Sci. Nat., vol. vii., p. 265, No. 2; Modèle No. 29.

P. burdigalensis, D'Orbigny, Brady, Parker, and Jones, 1870. Trans. Linn. Soc. Lond., vol. xxvii., p. 224, pl. xxxix., figs. 9*a*, *b*.

Remarks.—This species is distinguished by its compressed form, which, on one side at least, is decidedly concave; in this

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1 Journ. Northamptonshire Nat. Hist. Soc., vol. vii., 1892, p. 71, pl. ii., figs. 23, 24.

2 Mém. Soc. Géol. France, 1840, sér. 1 vol. iv., p. 23, pl. ii., figs. 4, 5 and 7.

3 *Idid.*, 1886, sér. 3, vol. iv., Mém. ii., p. 45, pl. iv., figs. 40-44.

latter respect it is separable from P. compressa, D'Orbigny. The chambers are somewhat regularly alternate. D'Orbigny's specimen came most probably from the middle tertiary near Bordeaux. It is already known as a jurassic species, having been recorded from the English Lias by Tate and Blake.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2143].

Polymorphina gutta, D'Orbigny. (Pl. XXII., Fig. 20).

Polymorphina (*Pyrulina*) *gutta*, D'Orbigny, 1826. Ann. Sci. Nat., vol. vii., p. 267, No. 28, pl. xii., figs. 5, 6; Modèle No. 30.

P. gutta, D'Orbigny, Jones, Parker, and Brady, 1866. Monogr. Crag. Foram., pl. 1, figs. 46, 47.

P. gutta, D'Orbigny, Chapman, 1894. Quart. Journ. Geol. Soc., vol. l., p. 715.

Id., 1896. Journ. Roy. Micr. Soc., p. 10, pl. ii., fig. 7.

Remarks.—This is a well-known neocomian and gault species, and it has also occurred in various tertiary strata.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2144.]

Polymorphina compressa, D'Orbigny. (Pl. XXII., Figs. 21, 22).

Polymorphina compressa, D'Orbigny, 1846. Foram. Foss. Vienne, p. 233, pl. xii., figs. 32-4.

Remarks.—The Australian specimens are not quite typical, since they are much broader than D'Orbigny's examples, and are sub-rhombic in outline; but the form is a very variable one, and it is perhaps better to refer it to this species rather than to regard it as a distinct form. In the prominence of the primordial chamber in at least one of our specimens it resembles P. bucculenta, Berthelin,[1] from the Gault of France; it also shows a paucity of chambers and a similar arrangement as in that species, but the segments are not quite so strongly inflated.

P. compressa is well distributed throughout the fossiliferous deposits commencing with the lias, and it is interesting to note that Parker and Jones record it from the oolite series of England.

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1 Mém. Soc. Géol. France, ser. 3, vol. 1, 1880, p. 58, pl. iv. (xxvii.), figs. 16*a*-17*b*.

Occurrence.—Rare; jurassic, Greenough River district, West Australia. [2145-6].

Family *Rotaliidae.*

Sub-family *Rotaliinae.*

Genus *Discorbina*, Parker and Jones.

Discorbina rosacea, D'Orbigny sp. (Pl. XXII., Figs, 23, 23*a*, *b*).

Rotalia rosacea, D'Orbigny, 1826. Ann. Sci. Nat., vol. vii., p. 273, No. 15; Modèle No. 39.

Discorbina rosacea, D'Orbigny sp., Brady, 1884. Rep. Chall., vol. ix., p. 644, pl. lxxxvii., figs. 1, 4.

D. rosacea, D'Orbigny sp., Chapman, 1894. Quart. Journ. Geol. Soc., vol. l., p. 719.

Remarks.—The occurrence of the above minute species is interesting as extending its range in time. It was previously recorded from the neocomian of England, besides being well-known as a tertiary fossil.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2147].

Genus *Truncatulina*, D'Orbigny.

Truncatulina wuellerstorfi, Schwager sp. (Pl. XXII., Figs. 24, 24*a*, *b*).

Anomalina wuellerstorfi, Schwager, 1866. Novara Exped., Geol. Theil, vol. ii., p. 258, pl. vii., figs. 105, 107.

Truncatulina wuellerstorfi, Schwager sp., Brady, 1884. Rep. Chall., vol. ix., p. 662, pl. xciii., figs. 8, 9.

T. wuellerstorfi, Schwager sp., Chapman, 1894. Quart. Journ. Geol. Soc., vol. l., p. 722.

Id., 1898, Journ. R. Micr. Soc., p. 3, pl. 1, figs. 3*a-c*.

Remarks.—This is another species which now has its range in time extended, since it was previously known only from the English neocomian of Surrey and the gault of Kent, as regards mesozoic strata. It is also a tertiary fossil. The example before us shows all the characters of the species, and especially

the tendency of the chambers to overlay one another at the sutural lines, whereas in T. lobatula the separate chambers are more inflated.

Occurrence.—One specimen; jurassic, Greenough River district, West Australia. [2148.]

Super-order OSTRACODA.

[All the following genera belong to the Family *Cytheridae*].

Genus *Cythere*, Müller.

Cythere drupacea, Jones, var. **fortior**, var. nov. (Plate XXIII., Figs. 3, 3*a*, 3*b*.

Remarks.—The type species was described by Professor Rupert Jones[1] from the boring at Richmond, Surrey, England, at a depth of 1205 feet, in a stratum of calcareous marl referred by Professor Judd to the great oolite. It was also found in the Bargate beds (neocomian, with possibly older, derived, fossils) of Guildford, Surrey.

Description.—The present variety, although closely approximating to the type species in general shape, differs in the modified ornament of the valves which, instead of consisting of a series of concentric wrinkles as in the type form, has a concentric series of pittings, which pass from the nearly circular in the median area to linear and parallel excavations nearer the margins, especially near the ventral and posterior borders. In our specimen the anterior flange is corrugated by a few divergent and flattened ridges. The ventral aspect of the carapace is roundly ovate and tumid in the posterior third. The end view is cordate. Length of specimen figured, 0.62 mm.; greatest height, 0.36 mm.; thickness of carapace, 0.36 mm. The valves were invariably found united.

Occurrence.—Rare; jurassic, Greenough River district, West Australia. [2149].

Cythere lobulata, sp. nov. (Pl. XXIII., Figs. 4, 4*a*, 4*b*.)

Specific characters.—Valves, seen from the side, sub-quadrate, narrowing towards the posterior extremity. Highest in the

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1 Quart. Journ. Geol. Soc., vol. xl., 1884, p. 772, pl. xxxiv., fig. 30.

anterior third. Anterior margin rounded on the ventral angle; obliquely rounded dorsally, having a marginal flange which is feebly corrugated. Carapace thickening towards the posterior extremity and becoming steep in front of the sub-acute posterior area. Surface swollen and somewhat lumpy, with indications of shallow pittings. Hingement showing the characteristic thin ridge, which fits into the furrow of the opposite (right) valve; tooth and fossa obscure. Length of valves, 0.6 mm.; greatest height, 0.3 mm.; thickness of carapace, 0.26 mm.

Affinities.—At first sight the shape of the species reminds one of Cytheridea trapezoidalis, Terquem,[1] but the form of hinge in the latter species is clearly that of a Cytheridea. Cythere harrisiana, Jones,[2] of the English cretaceous, also bears a general resemblance to our form in its outline, but the tumid portion of the posterior region in the latter is more oblique.

Occurrence.—One example (represented by a left valve); jurassic, Greenough River district, West Australia. [2150.]

Cythere corrosa, Jones and Sherborn, var. **grossepunctata**, var. nov. (Pl. XXIII., Figs. 5, 5*a*, 5*b*.)

Descriptive remarks.—The above variety is distinguished from the type form,[3] which was found in the fuller's earth oolite of Midford, near Bath, England, essentially in its more elongate carapace, and coarser and fewer pittings. The anterior flange-like margin is corrugated in this variety, and the posterior flange is striate.

Measurements.—Length of valve, 0.7 mm.; greatest height, 0.32 mm.; thickness of carapace, 0.32 mm.

Occurrence.—Fairly common; jurassic, Greenough River district, West Australia. [2151.]

Genus *Loxoconcha*, G. O. Sars.

Loxoconcha elongata, sp. nov. (Pl. XXIII., Figs. 2, 2*a*, 2*b*).

Specific characters.—Carapace, as seen from the side, elongate, ovate, flexuous in outline; with a sharply rounded, antero-ventral

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1 Mém. Soc. Géol. France, sér. 3, vol. iv., 1885, p. 31, pl. iv., figs. 20*a-c*.

2 See Jones and Hinde, Suppl. Mon. Cret. Entom. (Pal. Soc.), 1890, p. 16, pl. i., figs. 47-52.

3 Jones and Sherborn, Proc. Bath. Nat. Hist. and Antiq. F. Club, vol. vi., 1888, No. 3, p. 254, pl. ii., figs. 12*a-c*.

angle, and an obliquely rounded antero-dorsal. A thick flange runs round the front margin, especially developed towards the ventral angle; a similar one is seen on the sub-acute posterior extremity. Highest in the anterior third. Edge view of carapace ovate, tumid. Valve edges closely adpressed but not overlapping. End view sub-cordate. Surface of valves perfectly smooth. A group of ovoid muscle spots closely arranged around a ringlike centre is seen in the middle of each valve.

Measurements.—Length, 0.7 mm.; greatest height, 0.35 mm.; thickness of carapace, 0.34 mm.

Remarks.—Most of the known species described under this genus are recent forms, but Dr. G. S. Brady remarks[1] that, "many fossil species described by authors under various generic terms—Cythere, Cytherina, Bairdia, etc.—belong by rights to Loxoconcha."

The specimen figured here is probably a female, having regard to the comparative tumidity of the carapace, and its well-rounded angles.

Occurrence.—Rare; jurassic, Greenough River district, West Australia. [2152.]

Loxoconcha jurassica, sp. nov. (Pl. XXIII., Figs. 6, 6*a* 6*b*).

Specific characters.—Valves seen from the side, sub-rectangular; hinge-line slightly concave. Ends lipped and well rounded, the antero-dorsal angle obliquely curved. Surface of valve rising towards the postero-ventral, and forming a protuberance in that region. Edge-view depressed-ovate. End view sub-cordate. Surface of carapace ornamented with a few interrupted striae parallel with the ventral margin.

Measurements.—Length of valve, 0.43 mm.; greatest height, 0.21 mm.; thickness of carapace, 0.21 mm.

Affinities.—This species has the same general features as G. S. Brady's L. variolata,[2] although it differs from it considerably in certain respects, such as the linear arrangement of the surface pittings. Brady's species is found fossil in tertiary strata, and

1 Rep. Chall. Zool., 1880, vol. i., pt. iii., p. 116.

2 Trans. Zool. Soc., vol. x., pt. 8, 1878, p. 400, pl. lxviii., figs. 4*a-d*; Rep. Chall. Zool., *tom. sup. cit.*, p. 121, pl. xxix., figs. 6*a-d*.

it is also living at the present day, being recorded off Booby Island, in 6 to 8 fathoms.

Occurrence.—One carapace found; jurassic, Greenough River district, West Australia. [2153.]

Genus *Paradoxorhyncha*, gen. nov.

Generic characters.[1]—Carapace seen from the side sub-quadrate; dorsal and ventral lines with a slight convexity. Ventral border with a notch at the antero-ventral angle, in front of which is a beak similar to that in Cypridea. Posterior extremity produced into a beak-like process as in Cytherura. Right valve larger, overlapping the left. Habitat, most probably marine.

Remarks on the genus.—This striking form seems to combine certain characteristics of the genera Cypridea (a freshwater and estuarine genus) with Cytherura and Cytheropteron (marine forms). All the genera named have the two valves unequal, but whereas in Cypridea the left valve is the larger, in Paradoxorhyncha it is the right valve which overlaps; in this respect it agrees with the arrangement found in Cytherura and Cytheropteron. In the salient, almost wing-like, extension of the postero-ventral angle, Paradoxorhyncha further agrees with Cytheropteron, and the real relationship of the new genus probably lies nearer the last-named genus.

Paradoxorhyncha foveolata, gen. et sp. nov.

(Plate XXIII., Figs. 1, 1*a*, 1*b*).

Specific characters.—In addition to the above features, presumably generic, the following may be added. Carapace thickest at the posterior third. Seen from the side, the anterior margin is obliquely rounded at the angles, making the anterior extremity narrow; flanged on the extreme border. Surface of valve steep towards the ventral border, gently sloping away to the dorsal margin. Ornamented with somewhat closely set areolae or polygonal pittings, four, five or six-sided. Edge view of valve sub-rhomboidal, tumid. End view depressed cordate.

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1 Since these are founded on a single specimen they must be regarded only as provisional, pending the discovery of further specimens.

Measurements.—Length of valve, 0.67 mm.; height, 0.5 mm.; thickness of carapace, about 0.46 mm.

Occurrence.—One valve; jurassic, Greenough River district, West Australia. [2154.]

Genus *Cytheropteron*, G. O. Sars.

Cytheropteron australiense, sp. nov. (Plate XXIII., Figs. 7, 7*a*, 7*b*).

Specific characters.—Valves elongate-ovate, surface rising from the depressed dorsal area to a swollen or even ridge-like prominence along the ventral border; the summit of the ridge is in the middle of the ventral line, and its edge slopes away in a bold curve towards the antero- and postero-dorsal margin. Both extremities of valve rounded and depressed. Surface of valve marked with faint concentric striae, formed of interrupted pittings running parallel with the edge of the ventral prominence, and curving round to enclose the central area. Indications of the muscle attachments are seen as a cluster of five minute ovoid depressions, almost in the position of the median sulcus, which is often present in this genus.

Measurements.—Length of valve, 0.57 mm.; greatest height, 0.3 mm.; thickness of carapace, 0.3 mm.

Affinities.—The nearest allied form to the above species seems to be Cytheropteron concentricum, Reuss sp., and especially its variety virginea, Jones.[1] C. australiense differs from these mainly in the squarer form of the valve as seen from the side, the more ridge-like ventral prominence, and the rhomboidal edge-view of the carapace. It is, however, closely allied to Professor Jones's variety above referred to, and further specimens from Australia may show a still nearer relationship. It is worth noting in connection with the age of the above form and its allies, that the variety virginea had its range extended into the neocomian by the present author's discovery of the rich microzoic fauna of the Bargate beds in Surrey.

Occurrence.—A specimen with united valves; jurassic, Greenough River district, West Australia. [2155.]

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1 See Jones and Hinde, Suppl. Mon. Cret. Entom. (Pal. Soc.), 1890, p. 32, pl. i., figs. 14-17.

GENERAL SUMMARY.

The present series of Foraminifera very closely resembles, as a whole, that usually obtained from the oolite formation in Europe. The family of the Lituolidae is here represented by a single species of the genus Haplophragmium, of a form especially typical of mesozoic strata. The family of the Textulariidae is represented by a new species each of Textularia and Bulimina, both of which are, more or less, allied to types which have a wide range in time. The family Lagenidae contains the largest number of species, the nodosarines, comprising four genera—Marginulina, Vaginulina, Cristellaria, and Flabellina,—to which fifteen species and varieties are referred, four of which are new; these have altogether a strong oolite aspect. The polymorphines have three species, belonging to the genus Polymorphina, and have a generally unrestricted range both in time and space. The remaining two species belong to the family of the Rotaliidae, and represent the genera Discorbina and Truncatulina; these have also a wide distribution.

Of the Ostracoda there are seven species and varieties, all of which are apparently new. They are comprised within the genera Cythere, Loxoconcha, Cytheropteron, and Paradoxorhyncha, and are all members of the Family Cytheridae. The new genus Paradoxorhyncha is a peculiar form, in which the carapace resembles Cypridea in certain features, but is, on the whole, possibly allied more nearly to Cytheropteron and Cytherura. Two of the new varieties are referred to specific types which are essentially mesozoic. The remainder are new forms.

EXPLANATION OF PLATES XXII., XXIII.

Plate XXII.

Fig. 1.—*Haplophragmium neocomianum*, Chapman. Lateral aspect. × 1.

„ 2.—*Textularia crater*, sp. nov. Oral aspect. × 56.

„ 2*a*.— „ „ „ Lateral aspect. × 56.

„ 3.—*Bulimina gregorii*, sp. nov. Lateral aspect. × 112.

Fig. 3*a*.—*Bulimina gregorii*, sp. nov. Outline in cross-section. × 112.

„ 4.—*Marginulina compressa*, D'Orbigny. Lateral aspect. × 28.

„ 5.—*Vaginulina schloenbachi*, Reuss. Var. *interrupta*, nov. × 56.

„ 6.—*V. lata*, Cornuel, sp. Lateral aspect. × 56.

„ 7.—*V. strigillata*, Reuss. „ „ (fragmentary). × 56.

„ 8.—*V. intumescens*, Reuss. „ „ × 56.

„ 9.—*Cristellaria rotulata*, Lamarck sp. Lateral aspect. × 56.

„ 10.—*C. subalata*, Reuss. Lateral aspect. × 56.

„ 11.—*C. prominula*, Reuss. „ „ × 84.

„ 11*a*.— „ „ Peripheral aspect. × 84.

„ 12.—*C. decipiens*, Wisniowski. Lateral aspect. × 56.

„ 13.—*C. daintreei*, sp. nov. Lateral aspect. × 56.

„ 14.—*C. costata*, F. and M. sp., var. *compressa*, nov. Lateral aspect. × 56.

„ 15.—*C. costata*, F. and M. sp., var. *seminuda*, nov. Lateral aspect. × 56.

„ 16.—*C. cf. limata*, Schwager. Lateral aspect. × 56.

„ 17.—*Marginulina solida*, Terquem. Lateral aspect. × 55.

„ 18.—*Flabellina dilatata*, Wisniowski. „ „ × 56.

„ 19.—*Polymorphina burdigalensis*, D'Orbigny. Lateral aspect. × 56.

„ 20.—*P. gutta*, D'Orbigny. Lateral aspect. × 56.

„ 21, 22.—*P. compressa*, D'Orbigny. Lateral aspects. × 56.

„ 23.—*Discorbina rosacea*, D'Orbigny sp. Superior aspect. × 56.

„ 23*a*.—*Discorbina rosacea*, D'Orbigny sp. Inferior aspect. × 56.

„ 23*b*.—*Discorbina rosacea*, D'Orbigny sp. Peripheral aspect. × 56.

„ 24.—*Truncatulina wuellerstorfi*, Schwager sp. Superior aspect. × 56.

„ 24*a*.—*Truncatulina wuellerstorfi*, Schwager sp. Inferior aspect. × 56.

„ 24*b*.—*Truncatulina wuellerstorfi*, Schwager sp. Oral aspect. × 56.

Plate XXIII.

(All figures on this plate magnified 56 diameters).

Fig. 1.—*Paradoxorhyncha foveolata*, sp. nov. Right valve. lateral aspect.

„ 1*a*.—*Paradoxorhyncha foveolata*, sp. nov. Edge view, ventral aspect.

„ 1*b*.—*Paradoxorhyncha foveolata*, sp. nov. End view.

„ 2.—*Loxoconcha elongata*, sp. nov. Left valve, lateral aspect.

„ 2*a*.— „ „ „ Edge view of carapace.

„ 2*b*.— „ „ „ End view.

„ 3.—*Cythere drupacea*, Jones, var. *fortior*, var. nov. Carapace from right side.

„ 3*a*.—*Cythere drupacea*, Jones, var. *fortior*, var. nov. Edge view of carapace.

„ 3*b*.—*Cythere drupacea*, Jones, var. *fortior*, var. nov. End view.

„ 4.—*C. lobulata*, sp. nov. Left valve, lateral aspect.

„ 4*a*.— „ „ Edge view.

„ 4*b*.— „ „ End view of carapace.

„ 5.—*C. corrosa*, Jones and Sherborn, var. *grossepunctata*, var. nov. Left valve, lateral aspect.

„ 5*a*.—*C. corrosa*, Jones and Sherborn, var. *grossepunctata*, var. nov. Edge view of carapace.

„ 5*b*.—*C. corrosa*, Jones and Sherborn, var. *grossepunctata*, var. nov. End view.

„ 6.—*Loxoconcha jurassica*, sp. nov. Left valve. Lateral aspect.

„ 6*a*.—*Loxoconcha jurassica*, sp. nov. Edge view of carapace.

„ 6*b*.— „ „ „ End view.

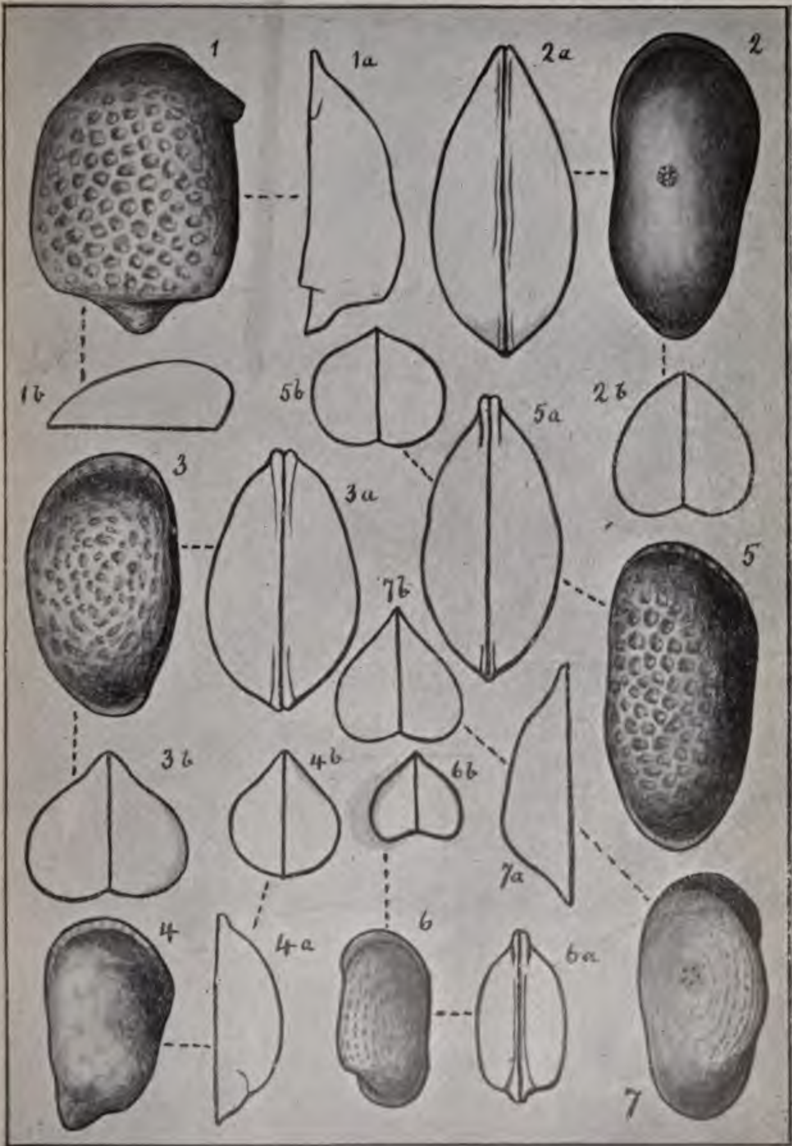
„ 7.—*Cytheropteron australiense*, sp. nov. Right valve, lateral aspect.

„ 7*a*.—*Cytheropteron australiense*, sp. nov. Edge view.

„ 7*b*.— „ „ „ End view.

F.C. *delt.*

Jurassic Microzoa.



F.C. *delt.*

Jurassic Microzoa.

ART. XIV.—*Notes on the Victorian Fossil Selenariidae, and Descriptions of some New Species (Recent and Fossil).*

BY C. M. MAPLESTONE.

(With Plates XXIV., XXV.).

[Read 8th October, 1903].

In the course of my examination of our Tertiary Polyzoa I found considerable difficulty in arriving at the correct names for some of the species of the family Selenariidae which references to the original descriptions did not remove, but rather increased, owing either to some of them not being satisfactorily described, or having been described from worn specimens, or the same name being given to different species, or the same species being described under different names.

The following is an endeavour to disentangle the confusion existing. I will first of all deal with those species which have been recorded as fossil.

Lunulites parvicella, T. Woods. T.R.S. S.A., 1879, p. 10.

The figures given by Dr. MacGillivray and Tenison Woods show the zoaria to be from 2 to 10 millimetres in diameter, but I have found fragments, which evidently belonged to zoaria of comparatively enormous size, 100 to 120 millimetres in diameter.

L. canaliculata, McG. T.R.S. V., 1895, p. 45.

This differs from the former species in the vibracular cells being in single linear series between the zooecia and not irregularly scattered as in that species.

L. rutella, T. Woods. T.R.S. S.A., 1879, p. 9.

L. aperta, T. Woods. T.R.S. S.A., 1879, p. 7.

L. aperta is merely a very much worn specimen of L. rutella.

L. biformis, McG. T.R.S. V., 1895, p. 46.

In specimens that I have of this species the central zooecia are entirely closed up, as is the case in some other species of this

family, and the partial filling up of them, which Dr. MacGillivray describes, is merely an intermediate stage in the closure, and there are not two forms of zooecia as implied in the description.

L. angulopora, T. Woods. T.R.S. S.A., 1879, p. 7.

This is not found fossil. It is living in New South Wales. The form described by Dr. MacGillivray (T.R.S. V., 1875, p. 46) as "?L. angulopora" is not this species. I have some small fragments of that form, which I have not been able to place, indeed I doubt if they belong to this family.

L. magna, T. Woods. T.R.S. S.A., 1879, p. 7.

This is referred by Mr. Waters (Q.J.G.S., 1885, p. 295) to the genus Microporella. I have not seen this species; it is not recorded for Victoria. It occurs in the Mount Gambier and Aldinga deposits.

L. guineensis, Busk. B.M.C. II., p. 98.

This has been recorded by Mr. Waters from Curdie's Creek. I have not found it in any of the material examined by me.

Capularia canariensis, Busk. Crag Polyzoa, p. 87.

I have found this in our Tertiaries, and Mr. Waters records it from Aldinga, S.A. These last two species should probably be united. In Miss Jelly's catalogue, L. guineensis is given as a synonym of C. canariensis.

Selenaria maculata, Busk. B.M.C. II., p. 101.

S. alata, T. Woods. T.R.S. S.A., 1879, p. 11.

Also living on the Australian coasts.

S. punctata, T. Woods. T.R.S. S.A., 1879, p. 9. (Pl. XXIV., Fig. 2).

S. fenestrata, Haswell. Pr. Linn. Soc. N.S.W., 1880, p. 42.

This species is not found fossil. Dr. MacGillivray quotes Haswell's species as a synonym, but it is very doubtful whether it be so, as all that Haswell says about it is that it differs from S. maculata "in the presence of two small fenestrae on the

front of each cell." He gives no figure. T. Woods described this species from a recent form from New South Wales, and he does not record it as fossil. The fossil form described and figured by Dr. MacGillivray is a very much larger one, the zooecia being four times as long and four times as broad as that described by T. Woods. I had assumed Dr. MacGillivray's identification to be correct, and I only discovered my mistake upon receiving from Mr. Whitelegge some specimens of the recent form, in answer to my request for some to compare with the fossil, because my specimens were not quite perfect; the vibracular areas were broken away. The dimensions of the zooecia of the fossil are 0.5 millimetre wide, 0.7 millimetre long; those of the recent form are 0.15 millimetre wide, 0.17 long, or only about one-sixteenth the size of those of the fossil. T. Woods' figure of S. punctata, though it shows the zooecia upside down, shows that they were very small, and Dr. MacGillivray, in his description of the fossil, says that "it differs from S. maculata, to which it is closely allied, in the *large* size of the zooecia and the stellate pores below the aperture." He must have overlooked the fact that Woods spoke of the small size of the zooecia as compared with those of other species, and Mr. Waters seems to have followed him in his identification, both evidently considering the two pores as being the principal, if not the only, characteristic separating that species from others. Two similar pores occur not only in this species and in the fossil, but also in two other forms which are described in this paper.

S. marginata, T. Woods. T.R.S. S.A., 1879, p. 9.

S. squamosa, McG. T.R.S.V., 1895, p. 48.

Lunulites initia, Waters. Q.J.G.S., Aug., 1883, p. 442.

Dr. MacGillivray, in his monograph of the Tertiary Polyzoa of Victoria, on page 48, describes a species as new, under the name S. squamosa, giving as synonyms S. marginata, T. Woods, and Lunulites initia, Waters. He says he was inclined to refer it to S. marginata as Mr. Waters had done, though as the description given by Woods disagreed with it in many particulars, and was so imperfect as to make the identification doubtful, he gave the species a new name; but, unfortunately, he gave it the same

name (squamosa) that Woods gave in 1880 to a species described by him in the Palaeontology of New Zealand, Part IV. (Corals and Bryozoa), p. 29, fig. 29, which is quite different. Now, although Woods' descriptions and figures are not very satisfactory, because he misunderstood the structure of the Selenariidae, I think his name (marginata) should stand for Dr. MacGillivray's S. squamosa; at the same time Woods' S. squamosa cannot stand, because it is evident that this species is the same as one he described in T.R.S. S.A., 1879, p. 8, as S. cupola, which name has been recognised by authors, and he has also described in the same paper as S. exigua one which I consider to be the same species; he says it is similar to S. cupola, and was "worn." This species (S. cupola) presents a very variable appearance according as it is either in a perfect condition or more or less worn; but I have no hesitation in uniting Woods' S. exigua and S. squamosa with it, one of the principal characteristics of which is the regular radiating series of the zooecia, for, though Woods in his description of S. squamosa, says "zooecia irregularly disposed," the figure shows them to be as regular as those of S. cupola.

In retaining the name S. marginata I would apply to it the description given by Dr. MacGillivray of his S. squamosa and its varieties. Lunulites initia, Waters, I consider to be merely a young form of this species.

S. concinna, T. Woods. T.R.S. S.A., 1879, p. 10.

Also living on the Australian coasts.

S. cupola, T. Woods. T.R.S.V., 1895, p. 49.

S. cupola, T. Woods. T.R.S. S.A., 1879, p. 14.

S. squamosa, T. Woods. N.Z. Pal., pt. iv., Cor. and Bry., 1880, p. 29.

S. exigua, T. Woods. T.R.S. S.A., 1879, p. 8.

The position of this species has been discussed in the remarks upon S. marginata, but I would note that I have a specimen of it in which the zooecia have two projecting points or spines on the outer or distal margin. Though Dr. MacGillivray's figure of this species shows that the marginal zooecia have an irregular distal border, indicating probably the presence of spines, he does

not figure nor mention any spines on the zooecia generally, but, through the kindness of Professor Spencer, I have been enabled to examine the specimen from which Dr. McGillivray's figure was drawn, and on some of the inner zooecia there are traces of spines, so that probably my specimen is a perfect form, and all the others more or less worn.

S. petaloides, D'Orbigny.

Lunulites petaloides, D'Orbigny. P.F.T.C., vol. v., p. 353, pl. 705, figs. 6-9.

Mr. Waters has, in Q.J.G.S., 1883, p. 442, recorded this as from Muddy Creek, and quotes S. cupola, T. Woods, as a synonym, but, as Dr. MacGillivray shows, this is an error, because in S. petaloides the zooecia are distinct behind, which they are not in S. cupola. I have a specimen of S. petaloides from the Beaumaris deposit, in which the outline of each zooecium is distinctly seen on the dorsal surface.

In my remarks upon S. punctata I have said that it is not found fossil, and that there is an enormous difference in the size of the zooecia of this and the fossil form. I have lately had a quantity of Polyzoa, dredged by Dr. Verco in South Australian waters, for examination, among which were several specimens of a form allied to S. punctata, in which the zooecia are intermediate in size between it and the fossil, namely, 0.3 millimetres wide and 0.2 to 0.25 long; and since then I have received from Mr. Whitelegge another form from Wollongong, N.S.W., in which the zooecia are about the same size. All these forms have two pores in the front wall of the zooecia, but that is the only characteristic in common; in all other respects they differ from one another. I have therefore considered it advisable to re-name the fossil form S. magnipunctata; the South Australian form I have named S. bimorphocella, in allusion to the two sizes of zooecia in the adult form; and the Wollongong form S. partipunctata, as the vibracular cells are not completely covered with punctures, leaving to the N.S.W. (Port Jackson) form the name S. punctata, by which it was originally described by Woods.

The following are the descriptions of these four species, and I wish to state that I have used the term "thyrostome" (oral aperture) as it has been applied by Dr. MacGillivray, not only to

the aperture in the membranous layer (ectocyst), but also to the aperture in the calcareous layer (cryptocyst), though for the latter the term "opesia" would be more correct.

S. magnipunctata, nom. nov. (Pl. XXIV., Fig. 1).

S. punctata, McG. T.R.S.V., 1895, p. 47.
" Waters. Q.J.G.S., Aug., 1883, p. 440.
" Waters. A.M.N.H., Sept., 1887, p. 201.
? S. fenestrata, Haswell. Pr. Linn. Soc. N.S.W., 1880, p. 42.

"Zoarium discoid, convex; zooecia in irregularly radiating series, wider above, lamina finely granular, inferior and lateral parts depressed, rising to the aperture below which on each side is a large stellate pore; aperture large, rounded above, straight or slightly hollowed below; vibracular cells large, with a distinct margin, cribriform. Posterior surface of zoarium with radiating convex ridges, with large round pores, and separated by deep furrows, at the bottom of which are raised lines" (McG.).

Localities.—Lower beds Muddy Creek (T. S. Hall); Mitchell River and Jimmy's Point (J. Dennant).

I have given Dr. MacGillivray's description, as it is evidently from a better preserved specimen than mine, of which, however, I have figured four zooecia to compare with the other figures; all the figures are drawn with the camera lucida to the same scale.

S. punctata, T. Woods. T.R.S. S.A., 1879, p. 9. (Pl. XXIV., Fig. 2).

Zoaria small, discoid, massive, convex or roundly conical, from two to four millimetres in diameter. Zooecia ovate (0.15 millimetre wide, 0.17 long), irregularly arranged. Thyrostome arched above, nearly straight below; two small pores below it. Vibracular cells much larger than the zooecia, very finely punctate, with a very prominent anvil-shaped articulation, inside the opening, for the vibraculum. Dorsal surface ribbed, with round pores.

Localities.—Port Jackson and Port Stephens, N.S.W., and Princess Charlotte Island, Queensland (T. Whitelegge).

This is distinguished by the uniformly small size and great convexity of the zoarium, the small zooecia and by the vibracular

cell being very much larger than the zooecial cells. I have not seen the vibracula, there are none preserved upon the specimens I have. This is the form, as before stated, which Woods described as S. punctata, it is not found fossil, and I have described it from my specimens as, in his description, he has mistaken the distal end of the zooecium for the proximal and the vibracular cells for ooecia.

S. bimorphocella, nov. sp. (Pl. XXIV., Fig. 3).

Zoaria discoid, up to 1 cm. in diameter, slightly convex. Zooecia, 0.3 mm. wide, 0.2 long, imbricate, in very regular linear series, the distal margin being nearly a semicircle, the lateral and proximal margins are formed by the distal margins of the adjoining zooecia. In some of the larger (adult) zoaria, there are on the margin one or two rows of zooecia more than double the size of those in the other portion of the zoaria, about 0.4 mm. long, and the same wide, and on the extreme margin there are some large, apparently imperfect, zooecia with very large trifoliate apertures, which are seen when they are incinerated. The thyrostomes are arched above and nearly straight below, the membranous layer is raised (especially in the larger zooecia) into a convex elevation below the thyrostome. The two pores in the calcareous front wall are very rarely perceptible through the membranous layer. When incinerated the thyrostome in the normal zooecia are seen to be arched above, with a broad curved sinus below, in the angles of which are two round pores, so close to the proximal margin that sometimes it is either broken away, or not calcified, so as to resemble the thyrostome of S. maculata; but in the larger zooecia they are arched above and nearly straight below, the two pores are stellate and at some distance from the proximal margin. The vibracular cells are ovoid, closely punctate, the vibracula thick and nearly straight (only a portion is shown in the figure). The edge of the zoaria is covered with small granulations. Dorsal surface ridged, with numerous large round pores.

Locality.—St. Vincent's Gulf, S.A., 17 fathoms (Dr. Verco); Fossil, Jimmy's Point (J. Dennant).

This is separated from the other forms by the presence on the margin, of adult zoaria, of one or two rows of zooecia more than

twice as large as the normal ones, also by the very regular imbricate arrangement of the small zooecia, and the form of the vibraculum. Since I determined this species I found in the Jimmy's Point deposit some fragments of zooaria which agree exactly with the recent form, and show on the margin the characteristic large zooecia.

S. partipunctata, nov. sp. (Pl. XXIV., Fig. 4).

Zooecia discoid, 5 mm. in diameter, very convex, nearly hemispherical. Zooecia irregularly hexagonal, 0.3 mm. in diameter, the upper angles being rounded. Thyrostome arched above, proximal margin sometimes slightly incurved and having a convexity below. The two pores in the calcareous front wall are hardly ever perceptible through the membranous layer. Vibracular cells ovoid, much longer than broad, closely punctate, but the punctures are confined to an oval area, the extreme proximal portion and sides being smooth, with a projection at each upper angle; vibracula very long, slender, flexible and minutely ringed. In an incinerated specimen the proximal margin of the thyrostome is seen to have a broad mucro or projecting plate; the pores are stellate. In some zooecia near the margin the mucro is of different construction, it is triangular, with the sharp point projecting, and it is apparently connected with the front wall only at each proximal angle, below the level of the zooecial front wall, leaving a narrow space or slit between them, and there is a raised ridge above the thyrostome. In the zooecia on the extreme margin the calcareous front wall has, instead of two small pores, two large lenticular openings, causing them to assume an appearance similar to that of Caleschara denticulata.

Locality.—Wollongong, N.S.W. (T. Whitelegge).

This is separated from the other forms by the mucro in the thyrostome, the very long slender vibracula, and the form of the front wall of the marginal zooecia.

The three following species from South Australia have not been described before, and I have recently found one of them fossil.

S. hexagonalis, nov. sp. (Pl. XXIV., Fig. 5).

Zoarium discoid, 8 to 15 mm. in diameter, slightly raised in the centre. Under surface with radiating and bifurcating ridges

which, when incinerated, show one or two irregular rows of small pores. Zooecia hexagonal, with margins raised. Thyrostome large, nearly circular, with a narrow raised granular border. The zooecia in the central portion of the zoarium are sometimes covered with a granular calcareous growth, leaving two or more elongated openings on the face. Vibracular cells large, irregularly oval, with wedge-shaped perforations radiating from the median line.

Localities.—Investigator Strait, S.A., 15 fathoms; Royston Head, Yorke's Peninsula, S.A., 15 fathoms (Dr. Verco); Fossil, Jimmy's Point (J. Dennant).

In the shape of the zooecia this somewhat resembles S. marginata, T. Woods, but the form of the thyrostome is different, and the vibracular cells are large and oval, instead of being very small. I have figured a portion of an incinerated specimen, which shows the peculiar manner in which the older zooecia are closed, or nearly so, by calcareous growth.

I had found some fragments of this in the deposit from Jimmy's Point, and had put them aside for further examination; on comparing them with the recent form, I find they agree with it in every particular.

Lunulites patelliformis, nov. sp. (Pl. XXV., Fig. 6).

Zoarium thick, oval, much raised, one end sloping very abruptly; very large, 28 to 40 mm. long, 25 to 35 mm. wide, and 15 to 25 mm. high. Zooecia disposed in regular radiating lines, elongate, sides parallel, distal margin arched, proximal incurved, margins raised, granular or crenate, a more or less developed broad mucro in the proximal margin of some of the zooecia. Four small circular communication pores on the lateral walls in a transverse row near the upper surface. Vibracula in single longitudinal series between each row of zooecia; vibracular area elongated, slightly broader distally; vibracular mandible narrow, slender, with an acute apex. Under surface of zoarium with radiating ridges covered with an epidermis, when incinerated the calcareous layer is seen to be granulated, and there are disclosed a number of very large pores, varying considerably in size, irregularly placed, but sometimes longitudinally disposed, and

also irr cross lines dividing them into areas probabl correspon to the margins of the zooecia.

Localities.—St. Vincent's Gulf, and Backstairs Passage, 17 t 22 fathoms; Investigator's Strait, 15 to 20 fathoms (D. Verco) Newcastle, N.S.W. (T. Whitelegge).

L. repandus, nov. sp. (Pl. XXV., Fig. 7).

Zoarium thin, nearly circular, but with irregularly waved margins, much raised, apex central and slope of sides uniform, 24 to 33 mm. in diameter, 8 to 14 mm. high. Zooecia in radiating rows, very irregular in rgins raised, thyrostome very irregular in shape. V attered, area elongated, very large, broader distally; m .5 mm. long, thick, with pointed apex. Under surface m with radiating ridges covered with epidermis, but nerated they show two rows of pores, and only a fe es or divisions; surface smooth. There are abou r communication pores situated distally on each ia.

Localities.—Investigat o 20 fathoms; Royston Head, Yorke's Peninsula, 15 r. Verco).

This is very near the last ecies, but the zoaria are very much thinner, the zooec so regular in shape, the vibracula are very much large. osed irregularly.

ADDENDUM.

Since writing the above I have found in the Otway deposit two specimens of another new species of Selenaria, which I now describe, in order to make these notes as complete as possible.

Selenaria otwayensis, n. sp. (Pl. XXV., Fig. 8).

Zoarium small, oblong or oval, very convex, 5 mm. long, 3 mm. wide, and 2 mm. high. Zooecia in linear series, distinct; front surface orbicular, concave, granulated, with raised margins. Thyrostome arched above, sides nearly straight, proximal margin slightly incurved. In the older zooecia this margin is extended distally so as to form a long tongue, and ultimately the front wall is entirely closed up. Vibracular cells in linear series between the zooecia, smooth, with an auricular opening in the

1

2

3

3a

4a

4

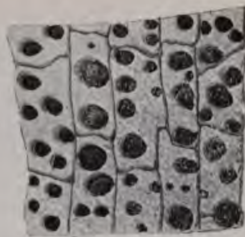
5

5a

5b

5c

6



6a

6b

6c

7

7a

7b

7c

8

proximal part and an uncalcified space in the distal part. Under surface of zoarium irregularly ridged.

Locality.—Cape Otway (J. Dennant).

This is a very distinct form. One specimen is oblong, with the corners rounded, the other is oval; the front wall of the zooecia is nearly circular and somewhat resembles that of S. marginata, but the very peculiar vibracular cells separate it from all other species. It has two openings, the proximal one being auricular in shape, and probably that in which the vibracula were articulated. It is also a very good exemplification of the closing up process which takes place in some species; each of the specimens shows cells partially and entirely filled up, and in the small portion figured there are several partially, and one entirely closed.

EXPLANATION OF PLATES XXIV. AND XXV.

Fig.	1.—	Selenaria	magnipunctata, nom. nov.	
,,	2.—	,,	punctata, T. Woods.	
,,	3.—	,,	bimorphocella, n. sp.	
,,	3*a*.—	,,	,,	(incinerated).
,,	4.—	,,	partipunctata, n. sp.	
,,	4*a*.—	,,	,,	(incinerated).
,,	5.—	,,	hexagonalis, n. sp. (incinerated).	
,,	5*a*.—	,,	,,	(dorsal surface).
,,	5*b*.—	,,	,,	(vibraculum).
,,	5*c*.—	,,	,,	(communication pores).
,,	6.—	Lunulites	patelliformis, n. sp. (incinerated).	
,,	6*a*.—	,,	,,	(dorsal surface).
,,	6*b*.—	,,	,,	(vibraculum).
,,	6*c*.—	,,	,,	(communication pores).
,,	7.—	,,	repandus, n. sp. (incinerated).	
,,	7*a*.—	,,	,,	(dorsal surface).
,,	7*b*.—	,,	,,	(vibraculum).
,,	7*c*.—	,,	,,	(communication pores).
,,	8.—	Selenaria	otwayensis, n. sp.	

All figures are magnified 50 diameters and reduced to 25.

Art. XV.—*Revision of Australian Lepidoptera.*

Family Geometridae.

By A. JEFFERIS TURNER, M.D., F.E.S.

[Read 8th October, 1903.]

Since Mr. Edw. Meyrick published a revision of the Australian Geometridae a little more than a decade ago, the number of new species described has been very large, and the group appears to be relapsing into confusion. Even in the first sub-family, the Hydriomeninae, in which there have been fewer additions than in the others, the number of recognised species has in the present revision been increased by one-half, and there has been a corresponding increase in the number of synonyms. This must be my excuse for this attempt, which is of course very largely founded on Mr. Meyrick's work. I have however endeavoured to exercise my own judgment on as much of the material as has been accessible to me, and the few instances in which I have been led to different conclusions are indicated in the text. I have examined the types in the British Museum collection described by Walker, and those in the Rothschild collection described by Mr. Warren. Many of the latter I have been able to identify, but some are unknown to me, and the time at my disposal did not permit of a thorough structural examination. Mr. Lower has kindly lent me the types described by him in the first two sub-families, which has been a most valuable help. Dr. Lucas's species I have identified to the best of my ability.

The names which should be attached to some of the larger and most widely distributed genera still remain in doubt; and the question can only be adequately settled by an historical inquiry, for which I have not the opportunity. This state of things, though unfortunate, may not be an unmixed evil, if it leads the student to concentrate his attention on the definitions, which are the real genera, and not wholly on the names, which are merely their tickets or labels.

Sub-family HYDRIOMENINAE.

With the exception of the genera Gymnoscelis and Chloroclystis, which are well represented in Queensland, and of the Indo-Malayan genus Sauris, this sub-family is almost entirely a temperate one, only a small minority of the species ranging into Southern Queensland. In Tasmania, Victoria, and the mountains of New South Wales there are numerous species especially of the large genus Hydriomena.

In the classification of the sub-family I have followed Mr. Meyrick for the most part, but have made use of a character pointed out by Sir George Hampson—the origin of vein 5 of the hind wings. This has introduced a difficulty, inasmuch as without an examination of the type species and an elaborate research through the older literature, both of which are impossible for me, I am not able to determine what generic names, among the many that offer themselves, should be applied to the groups so separated. I have therefore contented myself with dividing the genera Eucymatoge, Hydriomena, and Xanthorhoe into sections, and indicating in the following tabulation what I consider their natural arrangement. It will be comparatively easy at a later date to substitute generic names for these sections.

Most of the genera are more or less cosmopolitan. The small genera Scotocyma, Anomocentris, and Diploctena appear to be endemic.

I am particularly indebted to Mr. G. Lyell for examples of the Victorian species, both by gift and loan. Indeed, without his assistance I could hardly have undertaken this revision.

Mr. Lyell also, together with Mr. J. A. Kershaw, kindly identified for me five species described by Walker in his "Characters of Undescribed Lepidoptera Heterocera," from the types in the Melbourne Museum.

The aberrant genus Cleptocosmia, Warr., is not included in the following tabulation, but is given separately as an appendix to the sub-family.

Tabulation of Genera.

A.—Thorax and coxae not hairy beneath.

B.—Posterior tibiae without median spurs.

PAGE

C.—Face smooth. Posterior tibiae in ♂ without terminal spurs - - - 1. Sauris 222

CC.—Face with cone of scales. Posterior ae in ♂ with terminal spurs.

D.— ngue present. Antennae in ♂ simple - - - - 2. Gymnoscelis 224

DD.—Tongue absent. Antennae in ♂ pectinated - - - 18. Anomocentris 268

BB.—Posterior tibiae with median spurs.

C.—Fore wings with areole single.

D.—Fore wings w v 11 running into 12.

E.—Fore wing with vein 5 approximated at base to 4 - - 7. Microdes 237

EE.—Fore wings with vein 5 widely separate from 4 - - 3. Chloroclystis 228

DD.—Fore wings with vein 11 free.

E.—Abdomen with small segmental crests.

F.—Fore wings with tuft of raised scales in disc - - 4. Mesoptila 235

FF.—Fore wings without tuft of raised scales - - 5. Tephroclystia 235

EE.—Abdomen not crested.

F.—Face smooth - - - 8. Euchoeca 239

FF.—Face with projecting scales.

G.—Palpi ascending - - 11. Scotocyma 245

GG.—Palpi porrect - - 10. Scordylia 244

CC.—Fore wings with areole double.

D.—Face smooth - - - - 9. Asthena 240

DD.—Face with projecting scales.

E.—Hind wing with vein 5 approximated at base to 6, discocellular straight.

F.—Abdomen with segmental crests throughout 12. Eucymatoge (Sections I. and II.) 247

ris.

Sauris, Gn. X.. p.

Face smooth. Pa smooth-scaled. Antennae stout, laterally compress..., in ♂ very minutely ciliated. Posterior tibiae in ♂ without spurs, in ♀ with terminal spurs only. Fore wings with areole simple. Hind wings much distorted in ♂, in ♀ small, veins 3 and 4 stalked, 6 and 7 stalked, 8 anastomosing with cell to near end.

A remarkable genus of which the species appear to be very variable, and are best to be recognised by the extraordinarily complicated secondary sexual characters of the males.

Type.—S. hirudinata, Gn.

1. Fore wing of ♂ incised at tornus - - - - hirudinata
   Fore wing of ♂ not incised at tornus - - - lichenias

1. Sauris lichenias.

Remodes lichenias, Meyr. P.L.S. N.S.W., 1890, p. 806.

♂ with forewing not distorted at tornus; hind wing with veins 3 and 6 absent, inner margin turned over towards base, forming a large oval vesicle; wing not otherwise distorted.

In the only ♂ I have seen the abdomen and hind legs are damaged.

Type in Coll. Meyrick. Q., Brisbane. N.S.W., Sydney.

2. Sauris hirudinata.

Sauris hirudinata, Gn. Lep. x., p. 362. Hmps. Moths Ind., iii., p. 410.

Sauris remodesaria, Wlk. Brit. Mus. Cat. xxiv., 1253.

Sauris remodesaria, Moore. Lep. Ceyl., iii., pl. 207, f. 3, s. 2.

Sauris vetustata, Wlk. Brit. Mus. Cat. xxxv., p. 1680.

Remodes interruptata, Moore. Lep. Atk., p. 270.

Remodes triseriata, Moore. Lep. Ceyl. iii., p. 485, pl. 207, f. 1, 4.

Remodes elaica, Meyr. Tr.E.S., 1886, p. 193.

Remodes melanoceros, Meyr. Tr.E.S., 1889, p. 481, P.L.S. N.S.W., 1890, p. 805.

Remodes malaca, Meyr. P.L.S. N.S.W., 1890, p. 804.

Remodes cinerosa, Warr. Nov. Zool., 1894, p. 397.

♂ with fore wing distorted at tornus, being incised immediately above tornus, with a fringe of dense hair on lower margin of incision, and with a fovea containing a curved tuft of hair immediately beneath tornus; hind wings much distorted, veins 3 and 6 absent, base of inner margin turned over to form a vesicle, surmounted by a membranous lid, mid-termen incised and several times folded, forming a deep fovea containing dark hair on under side; abdomen with a pair of lateral pencil-like tufts near base; posterior tibiae with an outer tuft of hair at extremity.

Var. vetustata, from Brisbane. All green markings absent from head, body and fore wings, being replaced by grey, with dark fuscous lines on fore wings. This variety is so different in appearance that I should have regarded it as a distinct species if it were not that the secondary ♂ characters appear to agree accurately with the type form.

Swinhoe (Tr.E.S., 1902, p. 653) gives also Remodes angulosa, Warr (Nov. Zool., 1896, p. 382), and Remodes cirrhigera, Warr (Nov. Zool., 1897, p. 395), as synonyms.

N.Q., Townsville.

Q., Duaringa, Gympie, Brisbane, Stradbrooke Island.

Also from New Guinea, Fiji, Java, Sumatra, Ceylon, India, and Africa.

Genus 2. Gymnoscelis.

Gymnoscelis, Mabille. Ann. Soc. Ent. Fr. (4), vii., p. 656 (1867).

Face with short cone of scales. Palpi moderate, porrected, rough-scaled. Antennae in ♂ ciliated. Thorax glabrous beneath. Abdomen crested. Posterior tibiae in both sexes without median spurs. Fore wings with areole simple, 11 sometimes anastomosing with or running into 12. Hind wings with 8 anastomosing with cell from near base to beyond middle (Meyrick, Tr.E.S., 1892, p. 65).

Type.—G. pumilata, Hb., from Europe.

A small genus principally developed in the Indo-Malayan region. One species occurs in Europe, and Sir George Hampson records seven from India. The species are inconspicuous, and require careful discrimination.

1.	Fore and hind wings with a whitish spot on middle of termen - - - - - -	coquina
	Fore and hind wings without whitish terminal spot - - - - - - - - - -	2
2.	Fore wings greenish - - - - - - -	erymna
	Fore wings not greenish - - - - - -	3
3.	Hind wings with termen more or less projecting between veins 3 and 4 - - - - - -	4
	Hind wings with termen rounded - - -	5
4.	Terminal projection slight, fore wings with a looped antemedian line - - - - -	acidna
	Terminal projection strongly marked, fore wings without a looped antemedian line - -	minima
5.	Thorax with a dark fuscous, transverse, posterior bar - - - - - - - - -	delocyma
	Thorax without a dark transverse bar - - -	lophopus

3. Gymnoscelis lophopus, n. sp.

[λοφος a crest, and πους a foot; with crested feet].

♂ ♀, 15-16 mm. Head whitish; lower margin of face mixed with fuscous. Palpi whitish, mixed with fuscous. Antennae

whitish. Thorax whitish; a blackish transverse bar across middle of patagia. Abdomen ochreous-whitish, mixed with fuscous; tuft in ♂ large, white. Legs whitish; anterior pair mixed with fuscous; in ♂ anterior femora are clothed with long whitish hairs beneath, anterior tibiae with a large tuft of grey hairs at base, directed backwards, middle and posterior tibiae with dense apical tufts of dark leaden-grey hairs. Fore wings elongate, triangular, costa slightly arched, apex round-pointed, termen scarcely rounded, oblique; 11 anastomosing with 12; whitish, with reddish-brown irroration more marked in ♀, rarely greenish tinged; a few scattered black scales; several suffused basal lines best marked on costa; antemedian line sharply defined posteriorly, from $\frac{2}{5}$ costa to $\frac{2}{5}$ dorsum, with a rounded angle above middle; median line faintly indicated; postmedian line sharply defined posteriorly from $\frac{3}{5}$ costa to $\frac{3}{4}$ dorsum, once or twice acutely dentate; an acutely dentate whitish subterminal line; an interrupted fuscous terminal line; cilia whitish. Hind wings with termen rounded; colour and markings as in fore wings, but antemedian line not angled, postmedian line darker, and subterminal line indistinct not dentate.

The ♂ of this species is readily recognised by its tufted tibiae. In this it agrees with tibialis, Moore, from India, the type of Moore's genus Iramba, but I do not consider these tufts to be of generic value.

Type in Coll. Turner.

N. Q., Townsville, in June and July, and again in February. Seven specimens received from Mr. F. P. Dodd, who has found the larvae on Acacia aulacocarpa; Q., Brisbane.

4. Gymnoscelis coquina.

Gymnoscelis coquina, Warr. Nov. Zool, 1897, p. 69.

I have seen the types of this apparently very distinct species in Coll. Rothschild.

N. Q., Cooktown.

5. Gymnosceles erymna.

Eupithecia erymna, Meyr. Tr.E.S., 1886, p. 192.
Gymnoscelis erymna, Meyr. P.L.S. N.S.W., 1890, p. 794.

?Gymnoscelis subrufata, Warr. Nov. Zool., 1898, p. 24.

I have examined Warren's type, but cannot be sure whether it is identical with this species, of which I possess no examples.

Meyrick gives Queensland without further locality; Warren's type is from Duaringa. Also from New Guinea and Tonga.

Type in Coll. Meyrick.

6. Gymnoscelis delocyma, n. sp.

[δελος clear, distinct κυμα a wave; in allusion to the distinct markings on the forewings.]

♂ ♀, 12-16 mm. Head brown-whitish. Palpi dark fuscous, mixed with brown-whitish. Antennae with projecting scales at joints; ciliations in male $\frac{1}{4}$; brown-whitish annulated with fuscous. Thorax brown-whitish; posteriorly crossed by a broad fuscous posterior bar. Abdomen brown-whitish. Legs dark fuscous; posterior pair ochreous-whitish. Fore wings elongate-triangular; 11 running into 12; brown-whitish, with faintly indicated darker lines; markings blackish; a dot on costa near base, followed by some whitish scales; an inwardly oblique line from costa at $\frac{1}{3}$ to base of dorsum; an angulated line from costa at $\frac{1}{3}$ to dorsum at $\frac{1}{3}$, faintly marked towards dorsum, preceded by an obscure whitish line; an interrupted angulated line from costa at $\frac{2}{3}$ to dorsum at $\frac{2}{3}$, followed by a whitish line; a submarginal acutely dentate whitish line, immediately preceded by several blackish dots; an interrupted terminal line; cilia, basal half brown-whitish barred with fuscous, apical half grey, apices whitish. Hind wings rather narrow; colour and markings as in fore wings, but with only one basal line, which is obsolete except towards inner margin; posterior line obtusely angulated, slightly concave internal to angle; subterminal line acutely dentate. G. tristrigosa, Butl., from Formosa, is closely allied, but posterior line of fore wing is different in form.

Type in Coll. Turner.

N. Q., Townsville, in November, December, and February. Six specimens received from Mr. F. P. Dodd, who bred them from Scyphiphora hydrophylacea, the larvae turning over and fastening down the young foliage and feeding under cover like a pyrale.

7. Gymnoscelis minima.

Chloroclystis minima, Warr. Nov. Zool., 1897, p. 227.

♂ ♀, 12-13 mm. Head, thorax, and abdomen ochreous-whitish, sparsely irrorated with dark fuscous. Palpi dark fuscous. Antennae whitish, with a few fuscous annulations towards base; ciliations in ♂ $\frac{1}{4}$. Legs whitish; anterior pair fuscous, tarsi annulated with whitish. Fore wings triangular; 11 running into 12; whitish suffused with grey towards costa and termen, markings dark fuscous; basal and antemedian lines indistinct, except near costa; median line almost obsolete; postmedian line narrow, rounded, finely waved, with a pair of confluent dark fuscous dots above middle; a faint whitish subterminal line preceded by a dark suffusion on costa; no terminal line; cilia pale grey. Hind wings with termen excavated above middle, projecting between veins 3 and 4; colour and markings as in fore wings, but second line without spots and forming an obtuse projection below middle.

Type in Coll. Rothschild.

N. Q., Geraldton (Johnstone River); Q., Burpengary, near Brisbane, and Stradbrooke Island; in April and December, six specimens. It appears to be attached to Phyllanthus ferdinandi.

8. Gymnoscelis acidna, n. sp.

[ἀκιδνος, weak, feeble].

♂ ♀, 12-13 mm. Head whitish, irrorated with dark fuscous; face and palpi dark fuscous. Antennae whitish, towards apex fuscous. Thorax and abdomen whitish, irrorated with dark fuscous. Legs whitish, anterior pair fuscous. Fore wings elongate-triangular; whitish, with numerous suffused fuscous transverse lines; two or three very obscure basal lines; a fine antemedian line from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum, forming several obtuse projections or loops; a faint median line, closely followed by a broader postmedian line with a rounded angle above middle, nearly straight above and below angle; a fine wavy whitish subterminal line; a fuscous terminal line interrupted on veins; cilia pale grey, bases interrupted by whitish dots opposite veins. Hind wings with termen projecting somewhat between veins 3 and 4; colour and markings as in fore wings.

Type in Coll. Turner.

N. Q., Townsville, in December and February; six specimens received from Mr. F. P. Dodd.

Genus 3. Chloroclystis.

Chloroclystis, Hb. Verz., 323.

Face with short cone of scales. Palpi moderate, porrected, rough-scaled. Antennae in ♂ shortly ciliated, fasciculate-ciliated or naked. Thorax glabrous beneath. Abdomen crested. Posterior tibiae with all spurs present, or rarely with only a single proximal and two distal spurs. Fore wings with areole simple, 11 running into or anastomosing with 12. Hind wings with 8 anastomosing with cell from near base to beyond middle.

Type.—Chloroclystis coronata, Hb., from Europe.

This is probably a large genus, although there are but few European species. Pasiphila, Meyr., is a synonym. Phrissogonus, Butl., is here included, although Mr. Meyrick has regarded it as distinct. The secondary sexual characters of the ♂ do not appear to me here of generic value, as they are different in each species.

The species are small and inconspicuous, and are difficult to tabulate. The males of the first section are often very different from the females, and are most easily recognised by their secondary sexual characters.

There are no doubt many yet unrecognised species in the northern parts of Australia.

1.	Wings with transverse lines, mainly reddish-fuscous - - - - - - - -	2
	Wings with transverse lines not reddish-fuscous	3
2.	Hind wings with lines obsolete towards costa -	pyretodes
	Hind wings with lines not obsolete towards costa	filata
3.	Hind wings with lines distinct only towards inner margin - - - - - -	laticostata
	Hind wings with lines equally distinct throughout	4
4.	Hind wings with posterior line not angulated -	insigillata
	Hind wings with posterior line angulated - -	5
5.	Wings with metallic irroration - - -	metallospora
	Wings without metallic irroration - - -	6

6. Hind wings with termen excised above middle	catastreptes
Hind wings with termen rounded or slightly sinuate - - - - - - - -	7
7. Wings more or less greenish tinged - - -	8
Wings not greenish - - - - - - -	9
8. Wings with darker median band - - -	cissocosma
Wings without darker median band - - -	mniochroa
9. Hind wings with posterior line marked with dark longitudinal streaks - - - - -	10
Hind wings with posterior line without dark streaks - - - - - - -	12
10. Hind wings with posterior line acutely angulated	11
Hind wings with posterior line not acutely angulated - - - - - - - -	testulata
11. Fore wings with posterior line once angulated -	guttifera
Fore wings with posterior line twice angulated and wavy - - - - - - -	nigrilineata
12. Lower half of face dark fuscous - - - -	gonias
Face wholly grey - - - - -	ablechra

Section I.—Males with secondary sexual characters on fore wings (Phrissogonus).

9. Chloroclystis catastreptes.

Phrissogonus catastreptes, Meyr. P.L.S. N.S.W., 1890, p. 797.
Type in Coll. Meyrick.
N.Q., Mackay; Q., Brisbane; N.S.W., Sydney.

10. Chloroclystis testulata.

Eupithecia testulata, Gn. Lep. x., p. 352.
Scotosia denotata, Wlk. Brit. Mus. Cat., xxv., p. 1361.
Phibalapteryx parvulata, Wlk. Brit. Mus. Cat., xxvi., p. 1721.
Phrissogonus denotatus, Meyr. P.L.S. N.S.W., 1890, p. 798.

I cannot be sure from the description that Guenée's name applies to this species, but think it highly probable.

Var. a. ♀. Fore wings with central part of disc suffusedly whitish.

From Hobart (Coll. Lyell).

Var. b. ♀. Thorax, base of abdomen, base of fore wing, and an oblique line beneath apex, suffused with reddish.

From Gisborne (Coll. Lyell).

N.S.W., Glen Innes, Newcastle, Sydney, Bathurst, Cooma; V., Gisborne; T., Deloraine, Hobart; S.A., Mt. Lofty, Port Lincoln. Also from New Zealand.

11. Chloroclystis insigillata.

Eupithecia insigillata, Wlk. Brit. Mus. Cat., xxiv., p. 1245.

Eupithecia destructata, Wlk. Char. Undescr. Lep. Het., p. 80.

Phrissogonus insigillatus, Meyr. P.L.S. N.S.W., 1890, p. 799.

Type in British Museum.

N.Q., Townsville; Q., Brisbane, Southport; N.S.W., Glen Innes, Sydney; V., Gisborne, Melbourne; S.A., Mt. Lofty; W.A., Albany, Perth, York.

12. Chloroclystis approximata.

Larentia approximata, Wlk. Char. Undesc. Lep. Het., p. 79.

Phrissogonus pyretodes, Meyr. P.L.S. N.S.W., 1890, p. 799.

Type in Melbourne Museum.

Mr. Illidge has found the larvae of this species feeding on the flowers of acacia.

Q., Brisbane; N.S.W., Newcastle, Sydney; V., Melbourne, Gisborne; T., George's Bay.

13. Chloroclystis laticostata.

Larentia laticostata, Wlk. Brit. Mus. Cat., xxiv., p. 1196.

Scotosia canata. Wlk. Brit. Mus. Cat., xxv., p. 1357.

Phrissogonus laticostatus, Meyr. P.L.S. N.S.W., 1890, p. 801.

Type in British Museum.

Q., Duaringa, Nambour, Brisbane, Southport, Warwick, Dalby; N.S.W., Glen Innes, Sydney, Blackheath, Bathurst, Cooma; V., Gisborne, Warragul, Melbourne, Birchip; T., Hobart; S.A., Mt. Lofty, Port Lincoln; W.A., Albany, Geraldton, Carnarvon.

Section II.—Males without secondary sexual characters in fore wings (Chloroclystis).

14. Chloroclystis filata.

Eupithecia filata, Gn. Lep. x., p. 353.

Phibalapteryx rubroferrata, Wlk. Brit. Mus. Cat., xxv., p. 1341.

Pasiphila filata, Meyr. P.L.S. N.S.W., 1890, p. 795.

N.S.W., Sydney, Mt. Kosciusko; V., Melbourne, Gisborne; T., Deloraine, Hobart.

15. Chloroclystis metallospora, n. sp.

[μεταλλοσπορος, sprinkled with metal].

♂ ♀, 13-20 mm. Head and antennae grey-whitish. Palpi grey-whitish mixed with blackish. Thorax and abdomen whitish mixed with grey and dark fuscous, with scattered scales showing pale brassy reflections. Legs whitish, anterior pair fuscous; tarsi annulated with whitish; posterior tibiae with outer spurs about half as long as inner spurs. Fore wings elongate-triangular; grey-whitish irrorated with fuscous; many scales showing a brassy reflection in oblique light; markings blackish; a transverse line near base; two well-marked lines from costa before middle arising near together, first waved, second sigmoid, diverging towards inner margin at $\frac{2}{5}$ and $\frac{3}{5}$; a posterior line from costa at $\frac{2}{3}$ to before anal angle, first straight, sharply bent in middle of disc and thence inwardly curved; an obscure dentate whitish subterminal line; an interrupted black line along hind margin; cilia grey, apices and a series of dots opposite veins whitish. Hind wings as fore wings, but basal and median lines absent; second line with a prominent median acute projection.

Variety.—Median band of fore wing and hind wing between first and posterior lines wholly dark fuscous except towards costa, the fuscous suffusion extending in hind wing along inner margin nearly to base.

Q., Brisbane; taken rather commonly on fences in July, August and September.

16. CHLOROCLYSTIS CISSOCOSMA, n. sp.

[κισσοκοσμος, with ivy-green ornamentation].

♂ ♀, 16-18 mm. Head green mixed with white. Palpi dark fuscous mixed with whitish. Antennae grey; in ♂ with a short rounded process from upper surface of basal joint, ciliations minute ($\frac{1}{6}$). Thorax green mixed with whitish and fuscous. Abdomen whitish mixed with ferruginous, dark fuscous, and green. Legs whitish; anterior pair fuscous, tibiae and tarsi annulated with whitish; posterior tibiae with outer distal spur short, inner long, in ♂ very long and thickened, outer proximal spur absent. Fore wings elongate-triangular, costa in ♂ abruptly bent near base, in ♀ gently arched, termen bowed, oblique; green with fine white lines and fuscous blotches and suffusion; a broad median band partly suffused with fuscous, and followed by two fine white lines, posterior edge arched outwards and twice obtusely angled; a fine white dentate subterminal line preceded by three dark fuscous blotches on costa and above and below middle; a dark fuscous terminal line, narrowly interrupted by white on veins; cilia grey, narrowly interrupted by white opposite veins. Hind wings rather narrow, termen rounded, slightly indented at $\frac{1}{3}$ from costa; colour and markings as fore wings, but subterminal fuscous blotches less developed.

This species would be referable to Warren's genus Megatheca, which I think is not to be regarded as a distinct genus, the development of the proximal spurs of hind tibiae being variable in allied species, the outer spur tending to obsolescence. Compare with the following species.

Type in Coll. Turner.

Q., Brisbane, from May to August; four specimens.

17. CHLOROCLYSTIS MNIOCHROA, n. sp.

[μνιοχρωος, mossy-tinged].

♂ ♀, 15-19 mm. Head whitish; face and palpi whitish, irrorated with dark fuscous. Antennae whitish, towards apices grey; in ♂ with a thick ridge of dark grey hairs on middle half of upper edge, ciliations minute ($\frac{1}{8}$). Thorax and abdomen whitish mixed with dark fuscous and greenish. Legs fuscous, tarsal annulations and posterior pair whitish; posterior tibiae

with outer distal spur about $\frac{1}{2}$ inner, outer proximal spur about $\frac{1}{4}$ inner. Fore wings elongate-triangular, costa moderately arched, termen bowed, oblique; grey, greenish-tinged, with some fuscous irroration; partly irrorated with pale ferruginous towards costa; indications of a fuscous basal line; antemedian line fuscous from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, angled outwards in disc; postmedian line crenulate from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, arched outwards in disc and twice obtusely angulated, edged by a whitish line; a fine dentate whitish subterminal line; an interrupted fuscous terminal line; cilia grey interrupted by whitish opposite veins. Hind wings rather narrow, termen crenulate; colour and markings as fore wings.

Type in Coll. Turner.

Q., Nambour and Brisbane, in March, July, and November; three specimens.

18. Chloroclystis guttifera, n. sp.

[Guttiferus, marked by drops].

♂ ♀, 15-18 mm. Head and palpi white. Antennae grey-whitish; ciliations of male $\frac{1}{3}$. Thorax and abdomen white, irrorated with pale ochreous-fuscous; first three abdominal segments annulated and irrorated with blackish. Legs whitish, anterior pair mostly fuscous; posterior tibiae with inner spurs very long, outer spurs about $\frac{1}{4}$ as long. Fore wings elongate-triangular; white suffused with pale grey, which forms numerous obscure transverse lines, with a few scattered dark fuscous scales; markings dark fuscous; a line from costa at $\frac{1}{8}$ to inner margin near base; an obscure or incomplete line from costa at $\frac{1}{3}$ to inner margin at $\frac{1}{4}$; posterior line from costa at $\frac{2}{3}$ to inner margin at $\frac{2}{3}$, beneath angulation incomplete, being represented by short longitudinal lines along veins; a fine waved white subterminal line, preceded by small fuscous suffusions at and beneath costa; a narrow interrupted hind marginal line; cilia whitish, barred with grey. Hind wings rather narrow; termen scarcely crenulate; markings as fore wings, but basal line absent; posterior line very acutely angulated in disc, being represented only by longitudinal marks on veins.

Q., Brisbane, Stradbrooke Island; two specimens.

19. Chloroclystis nigrilineata.

Chloroclystis nigrilineata, Warr. Nov. Zool., 1898, p. 23.

I have seen only the type which is a ♀ without hind legs, but is probably correctly referred to this genus.

Q., Duaringa (Warren).

20. Chloroclystis gonias, n. sp.

[γωνία, an angle.].

♀, 22 mm. Head whitish; lower half of face and palpi dark fuscous. Antennae grey; basal joint whitish. Thorax brown-whitish; upper edge and apex of tegulae fuscous. Abdomen brown-whitish, with a longitudinal lateral blackish line as far as sixth segment; beneath this is a white blotch on fifth and sixth segments. Legs whitish; anterior pair infuscated; posterior tibiae with distal spurs long, inner twice as long as outer, proximal spurs very short, equal. Fore wings triangular; pale brownish, suffused with whitish; markings dark fuscous; traces of a basal line; a line along costa to $\frac{1}{3}$; a finely dentate, interrupted line from costa at $\frac{1}{3}$ to inner margin at $\frac{1}{3}$; a faintly marked whitish line from costa at $\frac{2}{3}$ to middle of inner margin; a strongly marked line from costa at $\frac{2}{3}$ sharply angulated just below middle of disc, thence slightly wavy to inner margin at $\frac{3}{4}$; a partly obsolete wavy whitish subterminal line; a dot on costa before apex; cilia whitish, mixed with pale brownish. Hind wings rather narrow; termen wavy; colour and markings as in fore wings, but basal and antemedian lines wanting; posterior line with a prominent double obtuse projection in disc below middle; succeeded by some whitish scales, and a white spot above anal angle; a white dot on termen opposite angle of posterior line.

Chloroclystis acygonia, Swin., from Assam, is closely allied.

Q., Brisbane; one specimen in September.

21. Chloroclystis ablechra, n. sp.

[ἀβληχρος, weak, feeble].

♂ ♀, 15 mm. Head grey-whitish. Palpi whitish mixed with dark fuscous. Antennae grey. Thorax and abdomen pale grey.

Legs whitish, anterior pair fuscous, tarsi annulated with whitish, posterior tibiae with outer spurs about half length of inner spurs. Fore wings elongate-triangular; pale grey, with faint indications of transverse lines; basal, antemedian, and postmedian lines mostly blackish; postmedian line angulated in middle, nearly straight above and below angle; a faint wavy or slightly dentate whitish subterminal line preceded on costa by a dark fuscous spot; a fuscous terminal line interrupted on veins; cilia whitish-grey. Hind wings with termen projecting somewhat between veins 3 and 4; colour and markings as in fore wings, but without blackish lines; a few blackish scales on an obtuse projection of middle of postmedian line. Under side whitish, with suffused fuscous antemedian and postmedian lines and a terminal band; fore wings with a median line towards costa; hind wings with a median dot.

A small obscure species recalling Gymnoscelis but with two pairs of spurs on posterior tibiae.

N.Q., Townsville, in July and again in February, four specimens from Mr. F. P. Dodd; Geraldton, in November, one ♀ in poor condition without blackish lines on fore wings.

Gen. 4. Mesoptila.

Mesoptila, Meyr. P.L.S. N.S.W., 1890, p. 794.

Face with small cone of scales. Antennae in ♂ unknown. Palpi moderate, porrected, rough-scaled. Abdomen slightly crested. Posterior tibiae with all spurs present. Fore wings with central tuft of erect scales in disc; areole simple. Hind wings with veins 6 and 7 stalked (Meyrick).

22. Mesoptila compsodes.

Mesoptila compsodes, Meyr. P.L.S. N.S.W., 1890, p. 794.

Type in Coll. Meyrick.

N.S.W., Sydney.

Gen. 5 Tephroclystia.

Tephroclystia, Hb. Verz., p. 323.

Face with short cone of scales. Palpi moderate, porrected, rough-scaled. Antennae in ♂ ciliated. Thorax glabrous beneath. Abdomen more or less distinctly crested throughout.

Posterior tibiae with all spurs present. Fore wings with areole simple; vein 11 free. Hind wings with 8 anastomosing with cell from near base to beyond middle (Meyrick, Tr. E.S., 1892, p. 65).

A genus containing numerous species, of which the majority are European. Sir Geo. Hampson records 20 species from India. It is hardly represented in our fauna, the species here described being only a straggler.

Eupithecia, Curt., is a synonym.

23. Tephroclystia melanolopha.

Eupithecia melanolopha, Swin. A.M.N.H. (6), xvi., p. 296. Hmps., Moths Ind., iv., p. 557.

♂, 13-14 mm. Head, palpi, antennae, and thorax ochreous-whitish. Antennae of male slightly serrate, ciliations $\frac{2}{3}$. Abdomen slightly crested on third and fourth segments; brown-whitish; apex of tuft dark fuscous. Legs fuscous; posterior pair whitish. Fore wings elongate-triangular; whitish, mixed with reddish-brown; in oblique light irrorated with leaden-metallic scales; a basal patch, fuscous towards costa, towards inner margin obsolete; a broad median band, towards costa fuscous, towards inner margin reddish-brown, containing a dark fuscous discal dot, and outlined anteriorly and posteriorly with whitish; an obscure whitish subterminal line, after which disc is suffused with fuscous; cilia fuscous, apices paler. Hind wings rather narrow; termen nearly straight; whitish mixed with fuscous and reddish-brown, darker towards inner margin; two distinct white lines start from inner margin at $\frac{3}{8}$ and near anal angle, becoming lost in disc; cilia pale fuscous, at anal angle white.

N.Q., Townsville, Queensland; in February and March. Three specimens received from Mr. F. P. Dodd. Also from India, Ceylon and Bali (British Museum Collection).

Gen. 6. Mnesiloba.

Mnesiloba, Warr. Nov. Zool., 1901, p. 196.

Head with short cone of scales. Palpi moderate, porrected, rough-scaled. Antennae in ♂ simple, very shortly ciliated. Thorax not hairy beneath. Abdomen with small dorsal crests. Posterior tibiae with two pairs of spurs. Fore wings with areole

double. Hind wings in ♂ with a deep indentation near tornus, separating a minute, not-folded anal lobe; vein 5 equidistant from 4 and 6 at base, discocellular straight; 6 and 7 stalked; 8 anastomosing with cell to near end.

Type.—M. eupitheciata, Wlk.

I have adopted Warren's genus, as the anal lobe of the ♂ hind wings hardly seems to correspond to that present in the European genus Lobophora, Curtis. In other characters it agrees with Eucymatoge, Hb.

24. Mnesiloba eupitheciata.

Phibalapteryx eupitheciata, Wlk. Brit. Mus. Cat., xxvi., p. 1720.

Cephalissa delogramma, Meyr. Tr.E.S., 1886, p. 195.

Lobophophora delogramma, Meyr. P.L.S. N.S.W., 1890, p. 807.

Eupithecia dentifascia, Hmps. Ill. Het., viii., p. 117, pl. 152, f. 12.

Eupithecia eupitheciata, Hmps. Moths of India, iii., p. 398.

Q., Brisbane; also from Fiji, Tonga, Ceylon and India.

Genus 7. Microdes.

Microdes, Gn. Lep. x., p. 296.

Face with short cone of scales. Palpi long, porrected, rough-scaled. Antennae in ♂ thickened, simple, naked or very shortly ciliated. Thorax not hairy beneath. Abdomen not crested. Posterior tibiae, with all spurs present. Fore wings with vein 5 from below middle of cell, more or less approximated to 4, 7 in ♂ widely separated from 8, 9, 10, the interval being occupied by a shallow depression on the upper surface, areole simple, 11 running into 12. Hindwings in ♂ often distorted or with a patch of altered scales, veins 6 and 7 stalked.

Type.—M. villosata, Gn.

The structure of vein 5 of the fore wings is unique in this family, but is doubtless correlated with the distorted neuration of the ♂, although present in both sexes.

1.	Fore wings with white transverse lines - -	typhopa
	Fore wings without white transverse lines - -	2

2. Fore wings with a thick black basal streak - melanocaust
   Fore wings with slight or no basal streak - -
3. Fore wings with posterior line with two projecting teeth - - - - - - - - diplodont a
   Fore wings with posterior line not toothed - - 4
4. Fore wings whitish-grey - - - - - - villosata
   Fore wings fuscous grey - - - - - squamulata

This tabulation applies to both sexes, but the males are most easily distinguished by the secondary sexual characters.

25. Microdes ata.

Microdes villosata, Gn. Lep. x., p 97, pl. xv., f. 8; Meyr., P.L.S. N.S.W., 1890, p. 802.

Panagra mixtaria, Wlk. Bri at., xxvi., p. 1663.

Microdes toriata, Feld. Rei v., l. cxxxi., f. 34.

N.S.W., Sydney; V., Me , Casterton, Gisborne; T., Launceston, Hobart; S.A., de, Mt. Lofty; W.A., Albany.

Felder refers this species to N d, no doubt erroneously.

26. Microdes squamulata.

Microdes squamulata, Gn. Lep. x., p. 298; Meyr., P.L.S., N.S.W., 1890, p. 803.

Oesymna stipataria, Wlk. Char. Undesc. Lep., Het., p. 80.

Q., Toowoomba; V., Melbourne, Gisborne; T., Launceston; W.A., Albany.

I have found the larvae on Acacia decurrens.

27. Microdes typhopa.

Microdes typhopa, Sow. Tr.R.S. S.A., 1897, p. 50.

I have examined the type (♀) of this very distinct species.

S.A., Adelaide (Semaphore).

28. Microdes melanocausta.

Microdes melanocausta, Meyr. P.L.S. N.S.W., 1890, p. 802.

Type in Coll. Meyrick.

This species is unknown to me.

29. Microdes diplodonta, n. sp.

[διπλοδοντος, doubly-toothed; in allusion to postmedian line of fore wings].

♂ ♀, 20-25 mm. Head, palpi, thorax, and abdomen brownish, mixed with ochreous-whitish and dark fuscous; in ♀ mostly ochreous-white. Palpi long (4-5). Antennae grey; in ♀ very shortly ciliated ($\frac{1}{3}$). Legs grey, annulated with whitish; posterior pair mostly whitish. Fore wings triangular, costa moderately arched, more strongly so near base, termen bowed; brownish mixed with dark fuscous and whitish, in ♀ whitish mixed with fuscous; veins partly but interruptedly outlined with dark fuscous; a very short, slender, basal streak parallel to dorsum; antemedian line ill-defined, outwardly curved, from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum; a double whitish postmedian line from $\frac{2}{3}$ costa obliquely outwards, forming two tooth-like projections in disc, and ending on dorsum at $\frac{3}{4}$; a slender, dentate, whitish subterminal line; an interrupted fuscous terminal line; all markings more obscure in ♀; cilia whitish, in ♂ rosy-tinged, more or less distinctly barred with fuscous. Hind wings with termen strongly bowed and somewhat wavy; pale grey; a fuscous terminal line; cilia whitish, obscurely barred with grey.

Structurally this species shows all the characters of the genus as above defined, but the hind wings of the ♂ show no abnormality.

Type in Coll. Lyell.

T., Mt. Wellington, in October; five specimens.

Genus 8. Euchoeca.

Euchoeca, Hb. Verz.

Face smooth. Palpi short, porrected, slender, loosely scaled. Antennae in ♂ shortly ciliated. Thorax glabrous beneath. Posterior tibiae with all spurs present. Fore wings with areole simple. Hind wings with 8 anastomosing with cell from near base to beyond middle (Meyrick).

1. Fore wings with areole small, vein 11 long, stalked with 8, 9, 10 - - - - - atrostrigata
   Fore wings with areole moderate, vein 11 arising separately from areole - - - - rubropunctaria

30. Euchoeca atrostrigata.

Epicyme atrostrigata, Warr. Nov. Zool., 1894, p. 394.

Asthena porphyretica, Low. Tr.R.S. S.A., 1896, p. 152.

Q., Rockhampton (Lower), Brisbane, two ♀ specimens.

There is a series in Coll. Rothschild said to be from Queensland. Though I cannot be quite sure of the identity of my example with these, I think it scarcely doubtful. The difference in the neuration between this and rubropunctaria is probably constant. Of the latter I have examined a series. The wings are ochreous-tinged, not pinkish-tinged as in rubropunctaria. Both species are variable.

31. Euchoeca rubropunctaria.

Ptychopoda rubropunctaria, Dbld. Dieff. N.Z., ii., p. 287.

Acidalia pulcharia, Wlk. Brit. Mus. Cat., xxiii., p. 780 (nec Dbld).

Asthena risata, Gn. Lep. ix., p. 438.

Asthena mullata, Gn. Ent. Mo. Mag. v., p. 42.

Asthena vexata, Wlk. Char. Undescr. Lep., Het., p. 78.

Euchoeca rubropunctaria, Meyr. P.L.S. N.S.W., 1890, p. 811.

Q., Duaringa, Brisbane, Toowoomba; N.S.W., Newcastle, Sydney; V., Melbourne, Fernshaw, Gisborne; T., Mt. Wellington, St. George's Bay. Also from New Zealand.

Genus 9. Asthena.

Asthena, Hb. Verz., p. 310.

Face smooth. Palpi short, porrected, slender, loosely scaled. Antennae in ♂ shortly ciliated. Thorax glabrous beneath. Posterior tibiae with all spurs present. Fore wings with areole double. Hind wings with 8 anastomosing with cell from near base to beyond middle (Meyrick).

Type.—A. candidata, Schiff., from Europe (Hampson).

1. Wings greenish - - - - - - - 2
   Wings not greenish - - - - - - - 7
2. Face green. Fore and hind wings with conspicuous dark discal dots - - - - - glaucosa
   Face not green. Fore and hind wings without conspicuous dark discal dots - - - 3

3.	Face ferruginous orange - - - - - -	4
	Face fuscous or ochreous-brown - - - -	5
4.	Hind wings with termen angulated - - -	urarcha
	Hind wings with termen evenly rounded - -	oceanias
5.	Fore wings with basal third of cilia grey - -	euphylla
	Fore wings with basal third of cilia not grey -	6
6.	Head green on crown - - - - - -	thalassias
	Head fuscous on crown (rarely white) - -	pulchraria
7.	Wings with ground colour yellowish-orange -	anthodes
	Wings with ground colour, not orange - -	8
8.	Hind wings with termen evenly rounded - -	xylocyma
	Hind wings with termen angled - - - -	9
9.	Hind wings with termen sinuate inwards on lower half - - - - - - . - -	scoliota
	Hind wings with termen not sinuate inwards on lower half - - - - - - -	10
10.	Fore wings with costa fuscous -	pulchraria var. decolor
	Fore wings with costa not fuscous - - -	euthecta

32. ASTHENA GLAUCOSA.

Iodis glaucosa, Luc. P.L.S. N.S.W., 1888, p. 1263.

Euchloris microgyna, Low. Tr.R.S. S.A., 1894, p. 85.

♀, 22 mm. Head green; fillet green, anterior margin narrowly white; face green (partly rubbed). Palpi whitish. Antennae whitish. Thorax green. Abdomen with several minute dorsal crests; green, sides and crests white. Legs whitish; anterior pair fuscous. Fore wings triangular, costa moderately arched, termen obliquely bowed; dull green, with obscure paler transverse lines; a narrow fuscous streak along costa except close to base and apex; a very conspicuous dark green discal dot, looking almost blackish; a terminal series of minute white dots opposite veins; cilia greenish. Hind wings with termen sharply angled on vein 4; colour and markings as fore wings.

Type in Coll. Lucas. The type of microgyna is in the Queensland Museum.

Q., Brisbane.

33. Asthena urarcha.

Asthena urarcha, Meyr. P.L.S. N.S.W., 1890, p. 812.

Type in Coll. Meyrick.

V., Ocean Grange, near Sale. One ♂ in Coll. Lyell. T., Deloraine. One ♂ in Coll. Meyrick.

34. Asthena oceanias.

Asthena oceanias, Meyr. P.L.S. N.S.W., 1890, p. 816.

Type in Coll. Meyrick.

V., Ocean Grange, near Sale. One ♀ in Coll. Lyell. W.A., Albany. Mr. Meyrick took one ♀ in September, and I took two ♀ in January. I think this and the preceding will prove to be sexes.

35. Asthena thalassias.

Asthena thalassias, Meyr. P.L.S. N.S.W., 1890, p. 813.

Asthena pellucida, Luc. P.L.S. N.S.W., 1892, p. 253.

Type in Coll. Meyrick.

Q., Rockhampton, Nambour, Brisbane, Mt. Tambourine; N.S.W., Sydney; V., Fernshaw.

36. Asthena pulchraria.

Acidalia pulchraria, Dbld. Dieff. NZ., ii., p. 286.

Asthena ondinata, Gn. Lep. ix., p. 438, pl. xix., f. 4 (poor); Feld., pl. 128, f. 17.

Chlorochroma plurilineata, Wlk. Brit. Mus. Cat., xxii., p. 563.

Asthena pulchraria, Meyr. P.L.S. N.S.W., 1890, p. 813.

N. var., decolor.

All the green markings replaced by pale ochreous-brown. At first sight this form appears very distinct, but I believe it will prove to be only a variety of this species. There is one ♂ in fine condition in Coll. Lyell, taken near Gisborne.

N.S.W., Glen Innes, Sydney, Blackheath, Bathurst, Mt. Kosciusko; V., Sale, Melbourne, Gisborne; T., Deloraine, Hobart; W.A., Albany. Also from New Zealand.

37. Asthena euphylla.

Asthena euphylla, Meyr. P.L.S. N.S.W., 1890, p. 815.
Type in Coll. Meyrick.
T., Deloraine, Hobart.

38. Asthena xylocyma.

Asthena xylocyma, Meyr. P.L.S. N.S.W., 1890, p. 814.
Type in Coll. Meyrick.
V., Melbourne (Lower); W.A., Albany.

39. Asthena scoliota.

Asthena scoliota, Meyr. P.L.S. N.S.W., 1890, p. 815.
Type in Coll. Meyrick.
W.A., Albany.

40. Asthena anthodes.

Asthena anthodes, Meyr. P.L.S. N.S.W., 1890, p. 816.
Type in Coll. Meyrick.
N.S.W., Sydney; V., Melbourne; S.A., Mt. Lofty.

41. Asthena euthecta, n. sp.

[εὐθηκτος, well-sharpened; in allusion to the fore wings.]

♀, 21-22 mm. Head ochreous whitish, face and palpi pale brownish fuscous. Antennae whitish. Thorax ochreous whitish, with two minute fuscous dots posteriorly Abdomen, ochreous-whitish, with a pair of fuscous dots on dorsum of each segment. Legs ochreous-whitish, irrorated with fuscous; anterior pair fuscous with whitish annulations. Fore wings triangular, apex acute, sometimes slightly produced, hind margin bowed, oblique, sinuate beneath apex; ochreous-whitish, with numerous transverse waved pale ochreous-brown lines, bearing fuscous dots; posterior line better marked, very obtusely angulated; a minute blackish discal dot; a series of fuscous terminal dots; cilia whitish, with a few dark fuscous scales. Hind wing with termen rather acutely angulated on vein 4; markings as in fore wings.

Type in Coll. Turner.
Q., Brisbane; V., Gisborne (Lyell).

Genus 10. Scordylia.

Scordylia, Gn.

Face with slight cone of scales. Palpi moderate, porrected, rough-scaled. Antennae in ♂ ciliated. Thorax glabrous beneath. Posterior tibiae with all spurs present. Fore wings with areole simple. Hind wings with vein 5 arising from nearer 4 than 6, discocellular angled; 8 anastomosing with cell to beyond middle.

Mr. Meyrick now includes this genus in Plemyria, Hb., but this appears doubtfully correct, for the only two European species which I have been able to examine, rivata, Hb., and sociata, Bkh., have vein 5 of hind wings approximated at base to 6. I have, therefore, retained the above name for want of a better, although I am unacquainted with the type.

Sir George Hampson would probably include the following species with Venusia, Curt., with which they agree in neuration, but differ in the ♂ antennae not being pectinated.

1. **Fore wings brownish-ochreous - - - - - 2**
   Fore wings fuscous - - - - - - 3
2. **Fore wings with white antemedian, median, and postmedian lines - - - - - leucophragma**
   Fore wings without white lines - - - - - emporias
3. Fore wings with median band with a long sharp posterior projection - - - - - - oxyntis
   Fore wings without long posterior projection on median band - - - - - - - decipiens

42. Scordylia oxyntis.

Scordylia oxyntis, Meyr. P.L.S. N.S.W., 1890, p. 817.
Type in Coll. Meyrick.
V., Melbourne.

43. Scordylia leucophragma.

Scordylia leucophragma, Meyr. P.L.S. N.S.W., 1890, p. 818.
Type in Coll. Meyrick.
Q., Mt. Tambourine, in October; V., Melbourne.

44. SCORDYLIA EMPORIAS, n. sp.

[ἐμπορος, a traveller, wanderer].

Plemyria emporias, Meyr. MS.

♂ ♀, 17-22 mm. Head, palpi, antennae, and thorax pale ochreous-brown. Palpi horizontally porrect, very long, 3, densely clothed with short rough scales. Abdomen above reddish-ochreous, edges of segments blackish, toward apex and at sides greyish. Legs whitish, irrorated with fuscous; anterior pair mostly fuscous. Fore wings elongate-triangular, hind margin rather strongly bowed, oblique, slightly sinuate beneath apex; pale ochreous-brown; basal area, median band, and a vague suffusion along hind margin brownish; markings blackish; an outwardly curved line from costa at $\frac{1}{6}$ to inner margin at $\frac{1}{6}$, bounding basal area; a second line parallel to this, obsolete towards costa; anterior line bounding median band from costa at $\frac{1}{3}$, thence nearly straight to inner margin at $\frac{1}{3}$; posterior line from costa before $\frac{2}{3}$, obtusely angulated in disc, thence concave to inner margin at $\frac{3}{4}$; median band contains a blackish irroration towards the inner margin, and a blackish ring in centre of disc; an irregular suffused blotch in disc towards apex, containing a whitish spot, from which proceeds an obsolete line, represented by several dots to before anal angle; an interrupted terminal line; cilia pale ochreous-brown, with a few fuscous scales. Hind wings rather narrow, hind margin rounded; brown-whitish without markings; cilia brown-whitish.

Q., Nambour, Brisbane, two specimens in November; N.S.W., Sydney, in December (Lyell).

45. SCORDYLIA DECIPIENS.

Cidaria decipiens, Butl. Tr.E.S., 1886, p. 438.
Scordylia decipiens, Meyr. P.L.S. N.S.W., 1890, p. 818.
Type in British Museum.
N.S.W., Sydney.

Genus 11. **Scotocyma**, nov.

[σκοτοκυμος, darkly waved].

Face with short cone of scales. Palpi ascending obliquely, or closely appressed to frons, rather short, rough-scaled. Antennae

in ♂ very shortly ciliated. Thorax not hairy beneath. Abdomen not crested. Anterior tibiae in both sexes with a long tuft of hair from under surface near base, closely appressed to tibia; posterior tibiae with two pairs of spurs. Fore wings with areole simple; veins 7, 8, 9, 10, 11 stalked. Hind wings with 3 and 4 separate, 5 approximated at base to 6, 6 and 7 stalked, 8 anastomosing with cell to beyond middle.

The palpi, neuration of both wings, and anterior tibiae distinguish this genus.

Type.—S. albinotata, Wlk.

46. SCOTOCYMA ALBINOTATA.

Scotosia albinotata, Wlk. Brit. Mus. Cat., xxxv., p. 1689.

Xanthorhoe (?) platydesma, Low. Tr.R.S. S.A., 1894, p. 7[illegible].

♂ ♀, 30-34 mm. Head and palpi brown, or reddish-brown mixed with dark fuscous. Antennae dark grey. Thorax and abdomen fuscous mixed with brownish. Legs dark fuscous, irrorated, and tarsi annulated with ochreous-whitish. Fore wings rather broadly triangular, costa moderately arched, termen bowed, oblique; brown variably mixed with brown-whitish and dark fuscous; a small dark basal patch with convex border, more or less distinct; median band darker, or paler, than rest of wing, sometimes marked with whitish spots or suffusion; anterior border outwardly curved, from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, sometimes edged with brown-whitish; sometimes a short, blackish, longitudinal bar in median band from convexity of anterior border; posterior border from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum, with a rather prominent double median projection, sometimes edged with brown-whitish or with whitish dots on veins; a slender, pale, dentate, subterminal line often obsolete, often marked by minute dots on veins, and by a larger pure white or whitish spot between veins 3 and 4: a blackish terminal line; cilia dark fuscous mixed with brownish. Hind wings with termen rounded, dentate; brownish-fuscous, with numerous fine, dark, transverse lines; sometimes a small, subterminal, white or whitish spot between veins 3 and 4: terminal line and cilia as fore wings. Underside grey, with whitish lines and median subterminal spot.

A very variable species. One ♂ in the Brisbane Museum has the whole of median band uniform dark fuscous.

Type in British Museum. Sir Geo. Hampson kindly examined the neuration of the type at my request.

Q., Duaringa, Brisbane.

Genus 12. Eucymatoge.

Eucymatoge, Hb. Verz.

Face with short cone of scales. Palpi moderate, porrected, rough-scaled. Antennae in ♂ ciliated. Thorax glabrous beneath. Abdomen more or less distinctly crested throughout. Posterior tibiae with all spurs present. Fore wings with areole double. Hind wings with 8 anastomosing with cell from near base to beyond middle (Meyrick).

Closely allied to Hydriomena, differing in the abdominal crests.

1.	Thorax with a posterior crest - - - -	2
	Thorax smooth - - - - - - - -	5
2.	Fore wings with posterior edge of median band angled - - - - - - -	3
	Fore wings with posterior edge of median band not angled - - - - - -	leucophanes
3.	Hind wings with many fine transverse lines - -	4
	Hind wings with few lines becoming obsolete towards costa - - - - - -	peplodes
4.	Fore wings with posterior edge of median band forming a single acute angle. Palpi $1\frac{1}{2}$ -	scotodes
	Fore wings with posterior edge of median band forming a double obtuse angle. Palpi $2\frac{1}{2}$ -	mortuata
5.	Fore wings with whitish spots, discal dot obscure	callizona
	Fore wings without whitish spots, discal dot very distinct - - - - - - -	ghosha

Section I.—Vein 5 of hind wings approximated to 6. Thorax with a posterior crest.

47. Eucymatoge peplodes, n. sp.

[πεπλωδης, like a robe or cloak].

♂ ♀, 16-22 mm. Head, palpi, thorax, abdomen brown-whitish mixed with dark fuscous. Thorax with a well-marked, bifid, posterior crest. Antennae fuscous; ciliations in male $\frac{1}{4}$. Legs

dark fuscous annulated with whitish; posterior pair whitish, with a few scattered, dark fuscous scales. Fore wings triangular; termen bowed, oblique; whitish mixed with fuscous and dark fuscous, the light and dark scales tending to form obscure narrow waved transverse lines; a blackish transverse line near base; a broad, darker, median band outlined by blackish lines; anterior line from costa at $\frac{1}{3}$ to inner margin at $\frac{1}{3}$, concave; posterior line from costa at $\frac{2}{3}$ to inner margin at $\frac{2}{3}$, with two prominent dentations in costal half of disc; immediately beyond this is a double whitish line, sometimes clear white except at margins; sometimes a waved, subterminal, whitish line can be traced; an interrupted dark fuscous terminal line; cilia whitish, mixed with fuscous and dark fuscous. Hind wings with termen rounded, not waved; whitish suffused with fuscous; transverse lines indicated towards inner margin; terminal line and cilia as in fore wings.

Q., Brisbane; taken rather commonly on fences, from July to November. Also from Warwick and Stanthorpe.

48. Eucymatoge scotodes, n. sp.

[σκοτώδης, dark-looking].

♂ ♀, 18-24. Head, palpi, thorax, and abdomen dark fuscous mixed with whitish. Palpi $1\frac{1}{2}$. Thorax with a small bifid posterior crest. Antennae dark fuscous; ciliations in ♂ $\frac{1}{4}$. Legs dark fuscous mixed with whitish; tarsi annulated with whitish. Fore wings triangular, termen slightly bowed, oblique, wavy; whitish densely irrorated with dark fuscous, which tends to form numerous fine wavy transverse lines; a blackish discal dot; outer edge of median band with a short, acute, angular projection in middle; disc before and beyond median band sometimes suffused with whitish; a fine waved whitish subterminal line; a blackish terminal line; cilia pale fuscous with a darker median line. Hind wings with termen slightly wavy, rounded; fuscous, with numerous fine dark fuscous transverse lines; a wavy whitish line from inner margin at $\frac{3}{4}$; a similar subterminal line; terminal line and cilia as in fore wings.

This appears to be the species described by Mr. Meyrick (P.L.S. N.S.W., 1890, p 853) as Hydriomena mortuata, Gn.

Q., Brisbane, Stradbrooke Island, Stanthorpe; N.S.W., Sydney. Six specimens.

49. EUCYMATOGE MORTUATA.

Camptogramma mortuata, Gn. Lep. x., p. 428.

Cidaria clandestinata, Wlk. Brit. Mus. Cat., xxv., p. 1408.

There are three specimens in the British Museum without exact locality, which correspond closely to Guenée's description. I hope this species will be re-discovered. It differs from the preceding in the doubly obtuse-toothed projection on postmedian line of fore wing.

50. EUCYMATOGE LEUCOPHANES.

Hydriomena leucophanes, Meyr. P.L.S. N.S.W., 1890, p. 856.

V., Sale (Lyell); T., Kelso (Lyell), Deloraine.

Section II.—Hind wings with vein 5 approximated to 6. Thorax smooth.

51. EUCYMATOGE GHOSHA.

Collix ghosha, Wlk. Brit. Mus. Cat., xxiv., p. 1249.

♀, 25-28 mm. Head, thorax, and abdomen brownish-fuscous. Palpi $2\frac{1}{2}$; ochreous-whitish, apex and middle of second joint blackish. Antennae grey. Legs fuscous; mid-tibiae of ♂ strongly dilated with a deep internal groove. Fore wings with costa gently arched, towards apex strongly arched, termen wavy, strongly bowed, oblique; brownish-fuscous, irrorated with dark fuscous, which tends to form numerous fine, waved, transverse lines; a conspicuous, blackish, discal dot; a dark fuscous spot in mid-disc at $\frac{3}{4}$, followed by a pale spot, this forms part of a more or less obscure pale line from costa at $\frac{4}{5}$; a dark terminal line interrupted on veins; cilia brownish-fuscous. Hind wings with termen crenulate, rounded; colour and markings as fore wings, but discal dot obsolete. Underside of both wings whitish, with very distinct, dark fuscous, discal dots, postmedian and subterminal lines, sometimes interrupted.

Not closely allied to any Australian species.

N.Q., Cooktown, Cairns; Q., Brisbane.

Also from Louisade Islands, Celebes, Ceylon, and India.

Section III.—Hind wings with discocellulars angled; vein 5 from nearer 4 than 6. Thorax smooth.

52. Eucymatoge callizona.

Hydriomena brujata, Meyr. P.L.S. N.S.W., 1890, p. 855, *nec* Gn., Lep. x., p. 444.

H. albinotata, Meyr. *Ibid*, *nec* Wlk., Brit. Mus. Cat., xxxv., p. 1689.

Hydriomena callizona, Low. Tr.R.S. S.A., 1894, p. 78.

Very variable in the extent of its white marking, the white spot opposite mid-termen appearing to be most constant.

Mr. Meyrick gives an excellent description of this species, but was mistaken in identifying it with those described by Guenée and Walker. Mr. Lower thought his species was different from Meyrick's, but it is the same. His type is probably now in Coll. Rothschild.

N.S.W., Sydney; V., Sale (Lyell); T., Billopp (Lower), Kelso (Lyell).

Genus 13. Heterochasta.

Heterochasta, Meyr. P.L.S. N.S.W., 1890, p. 808.

Face with slightly projecting scales. Antennae in ♂ shortly ciliated. Palpi rather short, porrected, loosely-scaled. Posterior tibiae with all spurs present. Fore wings in ♂ with tuft of hairs from inner margin near base; areole double. Hind wings in ♂ with vein 4 absent (coincident with 3), 5 nearer 4 than 6 at base, discocellular angled; 6 and 7 stalked; 8 anastomosing with cell to beyond middle.

Type.—H. conglobata, Wlk.

1. Fore wings with a white mark on mid-costa - lasioplaca
   Fore wings without a white mark on mid-costa - conglobata

53. Heterochasta conglobata.

Cidaria conglobata, Wlk. Brit. Mus. Cat., xxv., p. 1411.

Heterochasta conglobata, Meyr. P.L.S. N.S.W., 1890, p. 808.

Type in British Museum.

N.S.W., Sydney.

54. HETEROCHASTA LASIOPLACA.

Heterochasta lasioplaca, Low. P.L.S. N.S.W., 1897, p. 14.

I have taken one ♀ specimen settled on the trunk of Ficus macrophylla. It precisely corresponds to the type which is a ♀, though described as ♂. In the absence of the ♂ the generic position of this species cannot be regarded as settled.

Type in Coll. Lower.

Q., Brisbane.

Genus 14. Polyclysta.

Polyclysta, Gn. Lep. x., p. 375.

Face with small cone of scales. Antennae in ♂ shortly ciliated. Palpi moderate, porrected, loosely-scaled. Posterior tibiae with all spurs present. Fore wings with areole double. Hind wings in ♂ with vein 6 absent (coincident with 7), in ♀ 6 and 7 stalked; 5 from middle of discocellular which is angled; 8 anastomosing with cell to beyond middle.

Type.—P. hypogrammata, Gn.

55. POLYCLYSTA HYPOGRAMMATA.

Polyclysta hypogrammata, Gn. Lep. x., p. 376, pl. xxii., f. 4. Meyr., P.L.S. N.S.W., 1890, p. 809.

Q., Nambour, Brisbane, Mt. Tambourine. N.S.W., Sydney.

Genus 15. Protaulaca.

Protaulaca, Meyr. P.L.S. N.S.W., 1890, p. 810.

Face with somewhat projecting scales. Antennae in ♂ shortly ciliated. Palpi moderate, porrected, loosely scaled. Posterior tibiae with all spurs present. Fore wings in ♂ beneath with slight groove along vein 1, clothed with rather rough hairs, areole double. Hind wings in ♂ with irregular longitudinal groove above vein 1; veins 3 and 4 from a point or stalked; 5 from middle of discocellular, which is angled; 6 and 7 stalked; 8 anastomosing with cell to beyond middle.

Type.—P. scythropa, Meyr.

56. PROTAULACA SCYTHROPA.

Protaulaca scythropa, Meyr. P.L.S. N.S.W., 1890, p. 810.

Probably attached to Ficus.

Type in Coll. Meyrick.

Q., Brisbane; N.S.W., Sydney.

Genus 16. Hydriomena.

Hydriomena, Hb. Verz., p. 322.

Face with more or less projecting or loose scales, or with conical tuft. Palpi moderate, porrected, or sub-ascending, rough-scaled. Antennae in ♂ ciliated, rarely dentate or naked. Thorax often crested, glabrous beneath. Abdomen not crested, or with crests on two basal segments only. Posterior tibiae with all spurs present. Fore wings with areole double. Hind wings with 8 anastomosing with cell from near base to beyond middle (Meyrick).

This genus may be divided into two or three sections according to the neuration of the hind wings, two at least of which should, I think, be considered distinct genera. The overwhelming majority of the Australian species belong to the first section, but in a small British collection which I have examined, the majority belong to the second section. The genus is exclusively temperate, only five or six species being known at present to range as far as Southern Queensland. In Tasmania, Victoria, and the mountainous parts of New South Wales, the species are numerous, and no doubt many more will be discovered. For my material I am mostly indebted to Mr. G. Lyell.

As the additions to this genus are comparatively small, I shall not repeat Mr. Meyrick's tabulation (P.L.S. N.S.W., 1890, p. 820), but shall content myself with indicating the affinities of the new species.

Section I.—Hind wings with vein 5 approximated at base to 6.

57. Hydriomena phaedra.

Hydriomena phaedra, Meyr. P.L.S. N.S.W., 1890, p. 824.

This species is very variable in the coloration of the median band of fore wings, which sometimes contains a complete, or interrupted, snow-white fascia; sometimes this fascia is suffused with pale fuscous, and sometimes it is dilated so as to occupy most of the median band.

Type in Coll. Meyrick.

Q., Brisbane, Toowoomba; N.S.W., Sydney, Bulli.

58. HYDRIOMENA GYPSOMELA.

Hydriomena gypsomela, Low. Tr.R.S. S.A., 1892, p. 11.
Type in Coll. Lower.
V., Kewell; S.A., Adelaide.

59. HYDRIOMENA INTERRUPTATA.

Cidaria interruptata, Gn. Lep. x., p. 469, pl. ix., f. 6.
Hydriomena interruptata, Meyr. P.L.S. N.S.W., 1890, p. 825.
N.S.W., Bathurst; V., Gisborne; T., locality unspecified.

60. HYDRIOMENA RHYNCHOTA.

Hydriomena rhynchota, Meyr. P.L.S. N.S.W., 1890, p. 826.
Type in Coll Meyrick.
N.S.W., Mt. Kosciusko.

61. HYDRIOMENA ACTINIPHA.

Hydriomena actinipha, Low. Tr.R.S. S.A., 1902, p. 248.

Fore wings whitish with fuscous markings; a basal and subbasal transverse line; succeeded by a whitish or pale brownish band; a broad fuscous median band, enclosing a median discal dot, centre of band sometimes paler; several fine wavy transverse lines in band; anterior margin of band strongly concave; posterior margin with a strong median acute projection; both margins outlined in white; the postmedian white line succeeded by a whitish line, both interrupted opposite projection; a fine interrupted blackish terminal line; cilia whitish barred with fuscous. Hind wings pale grey; a fine whitish subterminal line; a fine fuscous terminal line; cilia pale grey.

Type in Coll. Lower.
S.A., Broken Hill.

62. HYDRIOMENA PSARODES, n. sp.

[ψαρώδης, greyish.]

♂, 27 mm. Head and face grey, with a few whitish scales. Palpi, $2\frac{1}{4}$; grey, with a few white scales towards base beneath. Antennae dark fuscous; in male dentate, dentations 1, ciliations 1. Thorax white mixed with dark fuscous. Abdomen whitish mixed

with grey. Legs dark fuscous mixed with whitish; tarsi annulated with whitish; fore wings with costa nearly straight, hind margin rounded, oblique; white mixed with pale greyish; markings dark fuscous; an outwardly curved line near base; median band grey mixed with dark fuscous, and containing a pale central band, in which is a dark fuscous discal dot; internal edge from costa at $\frac{1}{3}$ to inner margin at $\frac{1}{3}$, nearly straight, followed by dark fuscous spots on either margin, and above middle of disc; posterior edge from costa at $\frac{2}{3}$ to inner margin at $\frac{2}{3}$, with a very prominent outward angulation in disc, and preceded by a fine parallel line; a suffused greyish spot on costa before apex; an oblique dark fuscous mark from below apex, ending in a greyish suffusion, which is prolonged to anal angle, and immediately succeeded by a wavy whitish line; a fine, interrupted, blackish, hind-marginal line; cilia barred alternately grey and white. Hind wings grey; a very faint paler subterminal line; a fine, blackish, interrupted terminal line; cilia grey, apices paler. Hind wings beneath grey mixed with whitish, on veins whitish-ochreous; with a discal dot at $\frac{1}{3}$, a fine, dentate, fuscous, median line, and a submarginal series of fuscous dots.

In Mr. Meyrick's tabulation this falls with H. rhynchota, Meyr., from which it differs in the grey hind wings. It may be distinguished from H. actinipha, Low., by the anterior margin of median band of fore wings being nearly straight, not deeply concave.

T., Strahan; one specimen in October (Coll. Lyell).

63. Hydriomena lucidulata.

Cidaria lucidulata, Wlk. Brit. Mus. Cat., xxv., p. 1407.
Hydriomena lucidulata, Meyr. P.L.S. N.S.W., 1890, p. 827.
Type in British Museum.

N.S.W., Blackheath, Mt. Kosciusko; V., Melbourne, Gisborne; T., Deloraine.

64. Hydriomena conifasciata.

Chrysolarentia conifasciata, Butl. A.M.N.H., 1882, p. 93.
Hydriomena conifasciata, Meyr. P.L.S. N.S.W., 1890, p. 828.

Type in British Museum.

N.S.W., Blackheath ; V., Gisborne ; T., Hobart.

65. Hydriomena subrectaria.

Coremia subrectaria, Gn. Lep. x., p. 411.

Cidaria responsata, Wlk. Brit. Mus. Cat., xxv., p. 1409.

Melanthia casta, Butl. Cist. Ent., ii., p. 553.

Hydriomena subrectaria, Meyr. P.L.S. N.S.W., 1890, p. 829.

Q., Brisbane, Stradbrooke I. ; N.S.W., Bathurst, Jenolan, Mt. Kosciusko ; V., Gisborne, Sale ; T. (Guenée) ; S.A., Mt. Lofty.

66. Hydriomena percrassata.

Catopyrrha? percrassata, Wlk. Brit. Mus. Cat., xxiv., p. 1065.

Xanthorhoe percrassata, Meyr. P.L.S. N.S.W., 1890, p. 873.

The ♂ antennae are laminate with tufts of cilia as in H. vacuaria, Gn.

Type in British Museum.

Q., Brisbane (Wild); V., Melbourne, Gisborne.

67. Hydriomena anthracinata.

Camptogramma anthracinata, Gn. Lep. x., p. 425, pl. vii., f. 5.

Melanodes? atriplena, Wlk. Brit. Mus. Cat., xxi., p. 325.

Hydriomena anthracinata, Meyr. P.L.S. N.S.W., 1890, p. 830.

V., Gisborne, Warragul ; T., Launceston, Campbelltown, Hobart.

68. Hydriomena strumosata.

Coremia strumosata, Gn. Lep. x., p. 419.

Cidaria intentata, Wlk. Brit. Mus. Cat., xxv., p. 1406.

Cidaria solitata, Wlk. Brit. Mus. Cat., xxv., p. 1409.

Hydriomena strumosata, Meyr. P.L.S. N.S.W., 1890, p. 831.

Q., Duaringa? (according to Meyrick, but I think this may be an error) ; N.S.W., Bathurst, Mt. Kosciusko ; V., Gisborne ; T., Deloraine, George's Bay, Hobart, Launceston ; S.A., Mt. Lofty.

69. Hydriomena vacuaria.

Coremia vacuaria, Gn. Lep. x., p. 418.
Coremia quartanata, Gn. Lep. x., p. 419.
Coremia solutata, Wlk. Brit. Mus. Cat., xxv., p. 1319.
Xanthorhoe vacuaria, Meyr. P.L.S. N.S.W., 1890, p. 866.
Xanthorhoe paradelpha, Low. Tr.R.S. S.A., 1892, p. 11.

The ♂ antennae of this species are peculiar, and should lead to its ready recognition in spite of a certain degree of variability. They are laminate rather than pectinate, and appear to me to agree much better with Hydriomena than with Xanthorhoe. Those of H. strumosata are also laminate, though not to the same extent and with shorter cilia.

An examination of the type of solutata, Wlk., and a careful consideration of the description of quartanata, Gn., have convinced me that they are referable to this species rather than to strumosata, Gn.

V., Melbourne, Gisborne, Sale; T., Hobart; S.A., Adelaide, Mt. Lofty.

70. Hydriomena symphona.

Hydriomena symphona, Meyr. P.L.S. N.S.W., 1890, p. 832.
Type in Coll. Meyrick.
N.S.W., Mt. Kosciusko.

71. Hydriomena cataphaea.

Hydriomena cataphaea, Meyr. P.L.S. N.S.W., 1890, p. 833.
Type in Coll. Meyrick.
N.S.W., Mt. Kosciusko; V., Mt. Erica.

72. Hydriomena lamprotis.

Hydriomena lamprotis, Meyr. P.L.S. N.S.W., 1890, p. 833.
Type in Coll. Meyrick.
N.S.W., Bathurst; V., Melbourne, Gisborne; S.A., Mt. Lofty.

73. Hydriomena excentrata.

Coremia excentrata, Gn. Lep. x., p. 419.
Cidaria constipata, Wlk. Brit. Mus. Cat., xxv., p. 1405.

Cidaria bifusata, Wlk. Brit. Mus. Cat., xxv., p. 1406.

Hydriomena constipata, Meyr. P.L.S. N.S.W., 1890, p. 834.

Mr. Meyrick doubtfully assigns Guenée's excentrata to his previously described strumosata. From the description it appears to me distinct, and I do not think there is much doubt that it is the present species. Guenée specially directs attention to the brownish hind wings.

Mr. Lyell has taken some fine varieties of this species. Var. a. ♀, from Gisborne, has the median band wholly suffused with dark fuscous. Var. b. ♀, also from Gisborne, has dorsal two-thirds of median band clear white except discal dot and a slight suffusion near external edge.

N.S.W., Bathurst; V., Gisborne.

74. Hydriomena synchora.

Hydriomena synchora, Meyr. P.L.S. N.S.W., 1890, p. 835.

Type in Coll. Meyrick.

T., Hobart.

75. Hydriomena aglaodes.

Hydriomena aglaodes, Meyr. P.L.S. N.S.W., 1890, p. 836.

Type in Coll. Meyrick.

N.S.W., Mt. Kosciusko.

76. Hydriomena callima, n. sp.

[καλλιμος, beautiful].

♀, 24 mm. Head and palpi dark fuscous mixed with whitish-ochreous. Antennae fuscous. Thorax dark fuscous, irrorated with whitish-ochreous. Legs fuscous, irrorated, and tarsi annulated with pale ochreous. Fore wings triangular, costa slightly arched, termen slightly bowed, slightly oblique; dark fuscous mixed with whitish; basal area suffused with pale brownish; median band bounded by white lines; antemedian line fine, minutely dentate, slightly outwardly curved, from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum; a small, dark fuscous discal dot, followed by a fine, dentate, dark line from costa beyond middle, lost in disc; postmedian white line very conspicuous in costal half, with two fine

dentations beneath costa; dorsal half very slender, followed throughout by an ochreous line; a fine, dark fuscous terminal line; cilia dark fuscous mixed with pale ochreous; apices barred with whitish. Hind wings with termen rounded; orange-yellow; towards base irrorated with fuscous; several short transverse fuscous lines from inner margin; a broad, fuscous, terminal band interrupted in middle; a fine, interrupted, dark fuscous, terminal line; cilia pale ochreous, barred with fuscous. Underside pale ochreous; fore wings with dark fuscous dots on costa at $\frac{1}{4}$ and middle; broad postmedian and terminal dark fuscous bands, the latter containing a series of whitish dots. Hind wings with discal dot, postmedian and subterminal lines.

Allied to H. aglaodes, Meyr.

Type in Coll. Lyell.

T., Strahan, in February. One specimen.

77. Hydriomena imperviata.

Larentia imperviata, Wlk. Brit. Mus. Cat., xxiv., p. 1196.
Hydriomena imperviata, Meyr. P.L.S. N.S.W., 1890, p. 837.
Type in British Museum.
V., Gisborne, Kewell, Birchip; S.A., Mt. Lofty.

78. Hydriomena heteroleuca.

Hydriomena heteroleuca, Meyr. P.L.S. N.S.W., 1890, p. 837.
Type in Coll. Meyrick.
N.S.W., Mt. Kosciusko; V., Melbourne, Gisborne, Warragul.

79. Hydriomena doliopis.

Hydriomena doliopis, Meyr. P.L.S. N.S.W., 1890, p. 838.
Type in Coll. Meyrick.
S.A., Adelaide, Mt. Lofty.

80. Hydriomena languescens.

Coremia languescens, Rosen. A.M.N.H., 1885, p. 433, pl. xi., f. 8.

Hydriomena languescens, Meyr. P.L.S. N.S.W., 1890, p. 839.
Type in British Museum.

In Coll. Lyell there is a variety of the ♀ in which the hind wings have no yellow tinge, but are nearly concolorous with the fore wings.

V., Melbourne, Gisborne; T., Hobart.

81. Hydriomena trissophrica, n sp.

[τρισσοφρικος, three times rippled].

♀, 36 mm. Head and palpi grey; palpi $2\frac{1}{4}$. Antennae fuscous. Thorax and abdomen grey, irrorated with whitish. Legs whitish, irrorated with grey; anterior pair fuscous, annulated with ochreous-whitish. Fore wings broadly triangular; costa gently arched; termen slightly bowed, moderately oblique; whitish, partly irrorated with ochreous-whitish, with numerous fine, wavy, dark fuscous, transverse lines; median band whitish, with a small, black, median, discal dot; anterior edge slightly angled outwards in mid-disc, from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum; outer edge marked by a much waved dark line, somewhat indented beneath costa, with a prominent double median projection, from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum; preceded by two much waved lines in band; followed towards costa by a whitish mark; a distinct slightly wavy, whitish, subterminal line; an interrupted, fine, blackish, terminal line; cilia grey, apices paler. Hind wings with termen crenulate; whitish-grey, becoming whitish towards costa; three very obscure darker transverse lines from inner margin; an obscure, pale, subterminal line; an interrupted blackish terminal line; cilia whitish, mixed with dark fuscous. Underside whitish; with blackish discal dots and subterminal band on both wings, the latter interrupted in middle; fore wing also with a blackish postmedian band strongly outwardly angled.

Mr. Meyrick's tabulation falls with H. orthropis, from which it differs in the whitish median band.

Type in Coll. Lyell.

T., Mt. Wellington, in February; one specimen.

82. Hydriomena orthropis.

Hydriomena orthropis, Meyr. P.L.S. N.S.W., 1890, p. 840.
Type in Coll. Meyrick.
N.S.W., Mt. Kosciusko.

83. Hydriomena polycarpa.

Hydriomena polycarpa, Meyr. P.L.S. N.S.W., 1890, p. 841.
Type in Coll. Meyrick.
N.S.W., Mt. Kosciusko.

84. Hydriomena oxygona.

Hydriomena oxygona, Meyr. P.L.S. N.S.W., 1890, p. 842.
Type in Coll. Meyrick.
N.S.W., Mt. Kosciusko.

85. Hydriomena stereozona.

Hydromena stereozona, Meyr. P.L.S. N.S.W., 1890, p. 843.
Type in Coll. Meyrick.
N.S.W., Mt. Kosciusko; V., Mt. Erica.

86. Hydriomena chrysocyma.

Hydriomena chrysocyma, Meyr. P.L.S. N.S.W., 1890, p. 843.
Type in Coll. Meyrick.
N.S.W., Mt. Kosciusko.

87. Hydriomena perornata.

Lythria (?) perornata, Wlk. Brit. Mus. Cat., xxiv., p. 1056.
Hydriomena perornata, Meyr. P.L.S. N.S.W., 1890, p. 844.
Type in British Museum.
N.S.W., Mt. Kosciusko; V., Gisborne, Mt. Erica; T., Mt. Wellington.

88. Hydriomena mecynata.

Camptogramma mecynata, Gn. Lep. x., p. 424.
Camptogramma extraneata, Wlk. Brit. Mus. Cat., xxvi., p. 1717.
Camptogramma annuliferata, Wlk. Brit. Mus. Cat., xxvi., p. 1717.
Hydriomena mecynata, Meyr. P.L.S. N.S.W., 1890, p. 845.
N.S.W., Sydney, Bulli, Blackheath; V., Melbourne, Gisborne, Sale; T., Launceston, Deloraine, Hobart.

89. Hydriomena leucozona.

Hydriomena leucozona, Meyr. P.L.S. N.S.W., 1890, p. 846.

Type in Coll. Meyrick.

N.S.W., Mt. Kosciusko; V., Gisborne, Ballarat, Phillip Island; T., Launceston, Deloraine.

90. Hydriomena polyxantha.

Hydriomena polyxantha, Meyr. P.L.S. N.S.W., 1890, p. 847.

Type in Coll. Meyrick.

N.S.W., Mt. Kosciusko.

91. Hydriomena insulsata.

Camptogramma insulsata, Gn. Lep. x., p. 423.

Camptogramma ebuleata, Gn. Lep. x., p. 424.

Aspilates spoliata, Wlk. Brit. Mus. Cat., xxiv., p. 1074.

Camptogramma correlata, Wlk. Brit. Mus. Cat., xxv., p. 1330.

Cidaria fervidata, Wlk. Brit. Mus. Cat., xxv., p. 1408.

Hydriomena insulsata, Meyr. P.L.S. N.S.W., 1890, p. 846.

Hydriomena correlata, Meyr. P.L.S. N.S.W., 1890, p. 848.

Hydriomena ebuleata, Meyr. P.L.S. N.S.W., 1890, p. 849.

It is with some diffidence that I merge together the three forms distinguished by Meyrick, but I suspect the differences to be only varietal.

N.S.W., Bathurst, Mt. Kosciusko; V., Melbourne, Gisborne, Ballarat; T., Launceston, Deloraine, Campbelltown; S.A., Mt. Lofty, Port Lincoln.

Erroneously referred by Walker to New Zealand.

92. Hydriomena trygodes.

Hydriomena trygodes, Meyr. P.L.S. N.S.W., 1890, p. 851.

Type in Coll. Meyrick.

V., Gisborne, Melbourne; T., George's Bay.

93. Hydriomena crocota, n. sp.

[κροκωτος, saffron coloured].

♂, 26 mm. Head and face purple-reddish, mixed with ochreous. Palpi $2\frac{1}{4}$, purple-reddish. Antennae grey; dentate; dentations 1.

Thorax with a small bifid posterior crest; purple-reddish; in centre ochreous. Abdomen whitish-ochreous mixed with purple-reddish. Legs whitish-ochreous; anterior pair fuscous, annulated with whitish. Fore wings with costa gently arched, termen bowed, oblique; bright ochreous mixed with purple-reddish, which tends to form fine transverse lines; a purple-fuscous basal patch, well marked on margins, but suffused in centre with ground colour; a purple-fuscous median band, containing a faint discal dot, and indications of fine, wavy, reddish-purple, transverse lines; inner edge, from costa at $\frac{1}{3}$ to inner margin at $\frac{1}{3}$, outwardly curved; outer edge from costa at $\frac{3}{4}$ to inner margin at $\frac{3}{4}$, slightly waved above, sinuate towards inner margin; a purple-reddish submarginal suffusion; a purple-fuscous terminal line; cilia purple-reddish. Hind wings pale purplish-grey; posterior third suffused with whitish-ochreous; cilia purple-fuscous; apices reddish.

♀ differs as follows:— Fore wings with ground colour whitish with brown-reddish lines; median band fuscous rather than purple; a fine whitish waved subterminal line preceded by two blackish spots between veins 4 and 6. Hind wings whitish; towards termen purplish tinged; with faint fuscous transverse lines.

Nearest to H. trygodes, Meyr., but differs in the brighter and more distinctive colouring. If the two sexes are correctly associated it varies considerably.

V., Wandin South, near Melbourne (♂ type), in September; one specimen in Coll. Lyell; T., Mt. Wellington (♀) in February; one specimen in Coll. Lyell.

94. Hydriomena decreta.

Cidaria decreta, Wlk. Brit. Mus. Cat., xxxv., p. 1692.
Hydriomena decreta, Meyr. P.L.S. N.S.W., 1890, p. 852.
Type in British Museum.
W.A., Geraldton.

95. Hydriomena cryeropa.

Hydriomena cryeropa, Meyr. P.L.S. N.S.W., 1890, p. 853.
Type in Coll. Meyrick.
N.S.W., Hay; V., Kewell.

96. HYDRIOMENA PLAGIOCAUSTA, n. sp.

♂, 30 m.m. Head, palpi, antennae, thorax, and abdomen ochreous-brown. Palpi porrected, $2\frac{1}{4}$. Antennal ciliations $\frac{1}{4}$. Legs ochreous-fuscous; posterior pair paler. Fore wings triangular; termen waved, bowed, oblique; pale brownish, somewhat ochreous tinged; with numerous fine waved transverse fuscous lines; a short blackish transverse mark from inner margin near base; a conspicuous blackish streak from inner margin at $\frac{1}{4}$ very obliquely outwards, terminating abruptly in disc at $\frac{1}{3}$, beneath middle of costa; a fine blackish line from its extremity to mid-costa; posterior line thickened with blackish scales in second $\frac{1}{4}$, and immediately followed for that extent by a whitish line; a little posterior to this is a blackish line which extends obliquely inwards from immediately below apex; a fine blackish terminal line; cilia pale brownish mixed with fuscous. Hind wings with termen crenulate, rounded; pale brownish, towards inner margin with fine transverse fuscous lines, scarcely waved; terminal line and cilia as fore wings. A dull coloured species, easy recognisable by the oblique line on fore wings from inner margin.

T., New Norfolk, near Hobart, two specimens; S.A., Adelaide (Lower).

97. HYDRIOMENA SEVERATA.

Camptogramma severata, Gn. Lep. x., p. 428.

Phibalapteryx perfectata, Wlk. Brit. Mus. Cat., xxv., p. 1341.

Scotosia scitiferata, Wlk. Brit. Mus. Cat., xxv., p. 1357.

Cidaria promptata, Wlk. Brit. Mus. Cat., xxv., p. 1410.

Hydriomena severata, Meyr. P.L.S. N.S.W., 1890, p. 854.

This species has occasionally slight indications of abdominal crests, but these are frequently entirely absent, and are not sufficient to remove it to the genus Eucymatoge.

Q., Stradbrooke Island; N.S.W., Sydney, Bathurst; V., Melbourne, Gisborne, Sale; T., Campbelltown, Hobart; S.A., Mt. Lofty; W.A., Albany.

98. HYDRIOMENA ARACHNITIS, n. sp.

[ἀραχνη, a spider].

Hydriomena arachnitis, Meyr. M.S.

♀, 22 mm. Head, thorax and abdomen whitish, irrorated with dark fuscous. Palpi 3; whitish, irrorated with dark fuscous; at base white. Antennae grey. Legs fuscous, irrorated with whitish. Fore wings elongate triangular, costa straight, slightly arched towards apex; apex acute, slightly produced, termen wavy, bowed, oblique; whitish-grey, irrorated with dark fuscous, which forms numerous fine wavy obliquely transverse lines; a blackish discal dot; a fine blackish terminal line; cilia whitish, with a median grey line. Hind wings with termen crenulate, only slightly rounded; colour and markings as fore wings, but discal dot obsolete, and lines distinct only towards inner margin.

Readily distinguished from H. severata by the longer palpi. It is also not unlike the female of Melitulias glandulata, Gn., from which it may be distinguished by the absence of ochreous colouring and dark oblique subapical streak.

V., Gisborne; one specimen in April received from Mr. G. Lyell.

99. HYDRIOMENA SQUAMULATA.

Camptogramma squamulata, Warr. Nov. Zool., 1899, p. 341.

♂ ♀, 18-24 mm. Head and palpi dark fuscous; palpi slender (1-1¼). Antennae fuscous; in ♂ shortly laminate, ciliations ½. Thorax and abdomen dark fuscous, irrorated with grey-whitish. Legs dark fuscous irrorated with grey-whitish. Fore wings with costa gently arched, termen wavy, very slightly sinuate, oblique; dark fuscous mixed with grey-whitish, tending to form numerous obscure fine oblique dark and pale lines; median band usually ill defined; its posterior margin wavy, scarcely angled; sometimes a pale wavy subterminal line; an interrupted blackish terminal line; cilia fuscous; apices paler. Hind wings with termen rounded, wavy, slightly excised between veins 4 and 6; colour and markings as fore wings.

An obscure species. The excision of termen of hind wings appears to be its best characteristic.

Type in Coll. Rothschild.

V., Gisborne, Birchip, in March and July (Lyell); T., Hobart.

100. HYDRIOMENA PLESIA, n. sp.

[πλησιος, neighbouring, akin].

♂ ♀, 20-24 mm. Head dark fuscous. Palpi 2, densely scaled; dark fuscous, bases beneath whitish. Antennae fuscous; in ♂ slightly dentate, ciliations $\frac{1}{2}$. Thorax dark fuscous irrorated with grey. Abdomen dark fuscous mixed in ♂ with brownish, in ♀ with grey; a pair of blackish dots on dorsum of each segment. Legs fuscous, irrorated, and tarsi annulated with whitish. Fore wings with costa scarcely arched, termen bowed, wavy, oblique; in ♂ brownish, in ♀ whitish with obscure fuscous oblique lines; a small fuscous basal patch containing obscure darker lines; its margin rounded, oblique from $\frac{1}{3}$ costa to near base of dorsum; a fuscous median band, in ♀ paler and with oblique fuscous lines, with a blackish median discal dot; anterior edge concave; posterior edge with a projecting tooth beneath costa, and another more prominent in mid-disc, in ♂ with minute white dots on veins; an obscure pale subterminal line in ♂ with minute white dots on veins; an interrupted dark fuscous terminal line; cilia dark fuscous; apices whitish, mixed with fuscous. Hind wings with termen rounded, dentate, fuscous, with obscure fine darker transverse lines; an interrupted blackish terminal line; cilia as fore wings.

In Meyrick's tabulation this falls with H. rhynchota, from which it differs in the absence of white fasciae limiting median band of fore wings. At first sight it might be confused with H. squamulata, but the palpi, not to mention other points, are very different.

Type in Coll. Lyell.

V., Gisborne, in February and March; three specimens received from Mr. G. Lyell.

101. HYDRIOMENA LOXOCYMA, n. sp.

[λοξοκυμος, obliquely waved].

♀, 20-24 mm. Head dark fuscous, on crown irrorated with whitish. Palpi short ($1\frac{1}{4}$); dark fuscous. Antennae dark

fuscous. Thorax and abdomen dark fuscous, irrorated with whitish. Legs dark fuscous mixed with whitish. Fore wings triangular; costa nearly straight; apex acute; termen bowed, oblique; whitish, with numerous obliquely transverse dark fuscous lines; several fine basal lines; a darker antemedian line from $\frac{1}{3}$ costa to $\frac{1}{4}$ dorsum, very slightly outwardly curved; postmedian line very distinct, from $\frac{2}{3}$ costa to mid-dorsum, with a well marked outward projection beneath costa, and another more obtuse in mid-disc; one or two fine lines in median band; several fine lines follow postmedian; a fine whitish submedian line bordered by grey irroration; an oblique dark shade from apex; an interrupted black terminal line; cilia whitish with a fuscous median line, and barred with fuscous opposite veins. Hind wings with termen rounded; whitish, with suffused transverse fuscous lines, less marked towards base; terminal line and cilia as fore wings. Under side of fore wings fuscous with whitish irroration; of hind wings as upper side, but more distinctly marked.

A small and inconspicuous species, best distinguished by the form of postmedian line of fore wings.

Type in Coll. Lyell.

V., Birchip, in April; three specimens taken by Mr. D. Goudie.

Section II.—Hind wings with vein 5 not approximated at base to 6.

(a) Vein 5 from middle of discocellular, which is straight.

102. HYDRIOMENA MICROCYMA.

Hydriomena microcyma, Meyr. P.L.S. N.S.W., 1890, p. 840.

Type in Coll. Meyrick.

V., Gisborne; T., Campbelltown, George's Bay; S.A., Mt. Lofty.

(b) Vein 5 from below middle of discocellular, which is angled.

103. HYDRIOMENA SUBOCHRARIA.

Aspilates subochraria, Dbld. Dieff., N.Z., ii., 285; Butl., N.Z. Cat., pl. iii., f. 16.

Arsinoe subochraria, Meyr. Tr. N.Z. Inst., 1883, p. 73.

Camptogramma strangulata, Gn. Lep. x., p. 423.
Aspilates euboliaria, Wlk. Brit. Mus. Cat., xxvi., p. 1684.
Camptogramma fuscinata, Gn. Ent. Mo. Mag., v., p. 92.
Hydriomena subochraria, Meyr. P.L.S. N.S.W., 1890, p. 851.

Tasmanian specimens are duller in colouration, and more suffused with fuscous than those from other localities.

Q., Toowoomba, Warwick, Stanthorpe; N.S.W., Glen Innes, Ben Lomond (4500 feet), Armidale, Murrurundi, Sydney, Bathurst Cooma; V., Melbourne, Gisborne, Ballarat, Healesville; T., Deloraine, Hobart. Also from New Zealand.

104. HYDRIOMENA UNCINATA.

Camptogramma uncinata, Gn. Lep. x., p. 424.
Panagra approximata, Wlk. Brit. Mus. Cat., xxiii., p. 1002.
Panagra plurilineata, Wlk. Brit. Mus. Cat., xxiii., p. 1011.
Panagra intercalata, Wlk. Brit. Mus. Cat., xxiii., p. 1012.
Camptogramma replicata, Wlk. Brit. Mus. Cat., xxv., p. 1330.
Panagra revulsaria, Wlk. Brit. Mus. Cat., xxvi., p. 1665.
Cidaria gallinata, F. and R. Reis. Nov., pl. cxxxi., f. 8.
Hydriomena uncinata, Meyr. P.L.S. N.S.W., 1890, p. 850.

Q., Mt. Tambourine, Warwick, Stanthorpe; N.S.W., Sydney, Bathurst; V., Melbourne, Gisborne; T., George's Bay, Hobart; S.A., Mt. Lofty; W.A., Albany, Perth, Geraldton.

Genus 17. Melitulias.

Melitulias, Meyr. P.L.S. N.S.W., 1890, p. 857.

Face with short cone of projecting scales. Antennae in ♂ ciliated. Palpi moderate, porrected, rough-scaled. Posterior tibiae with all spurs present. Fore wings with areole double. Hind wings in ♂ with a discal patch of modified yellow scales; vein 5 approximated at base to 6, 6 and 7 stalked, 8 anastomosing with cell to beyond middle.

105. MELITULIAS GRAPHICATA.

Tephrina graphicata, Wlk. Brit. Mus. Cat., xxiii., p. 967.
Melitulias graphicata, Meyr. P.L.S. N.S.W., 1890, p. 857.
Type in British Museum.

N.S.W., Blackheath; V., Melbourne; T., Deloraine, Lefroy.

106. MELITULIAS GLANDULATA.

Phibalapteryx glandulata, Gn. Lep. x., p. 439, pl. 10, f. 6.
Eubolia undulata, Rosen. A.M.N.H., 1885, p. 432.
Melitulias glandulata, Meyr. P.L.S. N.S.W., 1890, p. 858.
V., Melbourne; T., Hobart.

107. MELITULIAS DISCOPHORA.

Melitulias discophora, Meyr. P.L.S. N.S.W., 1890, p. 859.
Type in Coll. Meyrick.
N.S.W., Mt. Kosciusko.

Genus 18. Anomocentris.

Anomocentris, Meyr. P.L.S. N.S.W., 1890, p. 860.

Face with very small cone of scales. Tongue absent. Palpi short, stout, porrected, rough scaled. Antenae in ♂ bipectinated throughout; pectinations ending in tufts of long cilia. Posterior tibiae in both sexes without median spurs. Fore wings with areole simple. Hind wings with vein 5 approximated at base to 6, 6 and 7 stalked, 8 anastomosing with cell to near end.

Type A. crystallota, Meyr.

1. Fore wings with a white longitudinal basal streak - - - - - - - - **crystallota**
   Fore wings without white basal streak - - **trissodesma**

108. ANOMOCENTRIS TRISSODESMA.

Anestia trissodesma, Low. P.L.S. N.S.W., 1897, p. 12.
Emmilitis trissodesma, Low. P.L.S. N.S.W., 1899, p. 84.

I have received three ♂ and one ♀ specimens of this interesting species from Mr. Lower. There is no doubt that it is correctly placed in this genus.

Type in Coll. Lower.
S.A., Broken Hill.

109. ANOMOCENTRIS CRYSTALLOTA.

Anomocentris crystallota, Meyr. P.L.S. N.S.W., 1890, p. 860.
Type in Coll. Meyrick.
W.A., Carnarvon.

Genus 19. **Diploctena**, nov.

[διπλοκτενος, with twofold comb; in allusion to the ♂ antennae].

Face with projecting scales. Palpi moderate, porrected, rough scaled. Antennae in ♂ bipectinated, with two pairs of fine pectinations on each segment; extreme apex simple. Thorax not hairy beneath. Posterior tibiae with all spurs present. Fore wings with areole double. Hind wings with vein 5 approximated at base to 6, vein 8 anastomosing with cell from near base to beyond middle.

An endemic development from Xanthorhoe, differing in the ♂ having two pairs of pectinations to each antennal segment. The species are of large size with rather elongate fore wings.

Type D. argocyma, n. sp.

1. Fore wings with median band, limited posteriorly by a white fascia - - - - - - argocyma
   Fore wings without white fascia - - - - nephodes

110. Diploctena argocyma, n. sp.

[ἀργυκυμος, white-waved].

♂, 36 mm. Head, palpi and thorax fuscous mixed with whitish; palpi $1\frac{1}{2}$. Antennae pale grey; in ♂ with two pairs of pectinations on each segment, a shorter proximal pair (2) and a longer distal pair (3), the pectinations being closely approximated at the divisions between the segments. Abdomen whitish, irrorated with fuscous; with pairs of dark dots on dorsum of third and fourth segments. Legs whitish, irrorated with fuscous; anterior pair mostly fuscous; posterior pair mostly whitish. Fore wings rather elongate, triangular; costa, slightly arched; termen slightly bowed, oblique; fuscous mixed with whitish; a darker basal area, outwardly convex; median band darker, containing a median discal dot; anterior edge bounded by a fine outwardly curved whitish line, from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum; posterior edge from $\frac{2}{3}$ costa to $\frac{3}{4}$ dorsum, with a small double-toothed median projection; immediately followed by a wavy white fascia, bisected by a fine fuscous line; a much waved fine white subterminal line; cilia whitish mixed with fuscous (imperfect). Hind wings with

termen rounded; whitish suffused towards inner margin with pale grey; three or four fine wavy fuscous transverse lines from inner margin; a whitish subterminal line; cilia whitish.

Type in Coll. Lyell.

V., Mt. Ellery, in December; one specimen.

111. Diploctena nephodes.

Xanthorhoe nephodes, Meyr. P.L.S. N.S.W., 1890, p. 874.

♂, 40 mm. Antennae of ♂ bipectinated, with two pairs of pectinations of equal length (3) on each segment, arising from the middle and extreme apex of each segment, and so fairly equidistant. Fore wings elongate triangular; costa nearly straight, except near base and apex; termen rather strongly bowed, oblique; pale grey with dark fuscous lines and irroration; a fuscous suffusion along costa; a basal line slightly outwardly curved; median band narrow, pale except at margins, with a well marked blackish median discal dot; margin defined by a moderately broad dark fuscous line, internally edged with pale brownish, and this again by five fuscous lines; anterior from $\frac{1}{4}$ costa to near mid-dorsum, nearly straight; posterior from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum, very slightly angled above middle; a dark outwardly curved slightly waved subterminal line, immediately followed by a whitish line; a fine blackish terminal line, preceded by pale brownish suffusion on veins; cilia grey. Hind wings with termen rounded, whitish-grey; on inner margin and termen suffused with darker grey; a pale subterminal line; a fine blackish terminal line; cilia grey.

Meyrick's type, which I have seen, is considerably wasted. I have, therefore, supplemented his description.

N.S.W., Mt. Kosciusko; V., Yarra track, between Marysville and Wood's Point, in November; one specimen in Coll. Lyell.

Genus 20. Xanthorhoe.

Xanthorhoe, Hb. Verz, p. 327.

Face with more or less slightly projecting scales or conical tuft. Palpi moderate, porrected, rough scaled. Antennae in ♂ bipectinated, apex usually simple. Thorax glabrous beneath. Posterior tibiae with all spurs present. Fore wings with areole

double. Hind wings with 8 anastomosing with cell from near base to beyond middle (Meyrick).

As in the case of Hydriomena, I think the two sections of this genus should rank as distinct genera. I have merged Acodia, Rosen., with the first section for reasons given below.

Section I.—Hind wings with vein 5 approximated to 6 at base.

112. Xanthorhoe pauper.

Acodia pauper, Rosen. A.M.N.H., 1885, p. 435, pl. xi., f. 7; Meyr., P.L.S. N.S.W., 1890, p. 861.

Xanthorhoe pelochroa, Low. Tr.R.S. S.A., 1894, p. 80.

This species is somewhat variable in colouration and form of postmedian line of fore wings. The head is sometimes of a very characteristic reddish-violet character. I have examined the neuration of four ♂ specimens. In three the posterior wall and bisecting vein of areole are completely absent, as in the definition of the genus Acodia. In the fourth there is a double areole perfectly devoloped. In view of this variability I think the genus Acodia must be dropped. This observation completely confirms Mr. Meyrick's explanation of the nature of this form of abnormal neuration.

Type in British Museum.

V., Fernshaw, Melbourne; T., Ulverstone, Hobart; W.A., Albany, Perth.

113. Xanthorhoe centroneura.

Xanthorhoe centroneura, Meyr. P.L.S. N.S.W., 1890, p. 863.

Type in Coll. Meyrick.

T., Hobart.

114. Xanthorhoe subidaria.

Coremia subidaria, Gn. Lep. x., p. 42.

Coremia cymaria, Gn. Lep. x., p. 414.

Coremia permissata, Wlk. Brit. Mus. Cat., xxv., p. 1317.

Coremia regulata, Wlk. Brit. Mus. Cat., xxv., p. 1318.

Coremia relictata, Wlk. Brit. Mus. Cat., xxv., p. 1318.

Coremia acutata, Wlk. Brit. Mus. Cat., xxv., p. 1319.

Cidaria sodaliata, Wlk. Brit. Mus. Cat., xxv., p. 1410.

Larentia feraria, Wlk. Brit. Mus. Cat., xxxv., p. 1672.
Coremia divisata, Wlk. Brit. Mus. Cat., xxxv., p. 1682.
Corema cristata, Wlk. Brit. Mus. Cat., xxxv., p. 1683.
Larentia gelidata, Wlk. Char. Undescr. Lep., Het., p. 79.

Q., Duaringa, Brisbane, Stradbrooke Island, Toowoomba; N.S.W., Glen Innes, Newcastle, Sydney, Mt. Kosciusko; V., Melbourne, Gisborne, Fernshaw; T., Hobart; S.A., Mt. Lofty; W.A., Albany, Perth.

Var. ♀ urbana.

N.Q., Townsville, Toowoomba; Q., Brisbane; N.S.W., Sydney, T., Hobart.

115. Xanthorhoe hyperythra.

Xanthorhoe hyperythra, Low. Tr.R.S. S.A., 1892, p. 12.
Type in Coll. Lower.
V., Melbourne, Gisborne, Sale; S.A., Adelaide.

116. Xanthorhoe rhodacris.

Xanthorhoe rhodacris, Low. Tr.R.S. S.A., 1902, p. 226.

♀ type. Palpi moderate (2). Distinguishable by the reddish ferrugineous fore wings, with apical patch of same colour on under side, and the very distinct subterminal lines on both wings. The ♂ is required to establish its generic position.

Type in Coll. Lower.
S.A., Penola.

117. Xanthorhoe agelasta, n. sp.

[ἀγέλαστος, grave, sombre].

♂, 24 mm. Head and thorax ochreous-whitish. Palpi 2½; ochreous-whitish, external surface mixed with fuscous. Antennae pale fuscous; pectinations 6. Abdomen ochreous-whitish, with paired dark fuscous dots on dorsum of third and fourth segments. Legs ochreous-whitish, irrorated with fuscous; anterior pair dark fuscous annulated with ochreous-whitish. Fore wings with costa slightly arched, termen almost straight, markedly oblique; ochreous-whitish with fuscous lines and irroration; an outwardly curved line near base; median band darker, except in centre, which contains a blackish discal dot; band obscurely outlined

with ochreous-whitish, anterior edge concave from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum, posterior edge with a short obtuse projection above middle, indented above projection, sinuate beneath, from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum; a short oblique fuscous suffusion beneath apex; a fine pale subterminal line; a fine interrupted blackish terminal line; cilia ochreous-whitish mixed with fuscous (imperfect). Hind wings with termen slightly rounded; ochreous-whitish; a dark fuscous discal dot; a well-marked dark fuscous line from inner margin nearly reaching costa; a fine waved pale subterminal line in a pale fuscous suffusion; cilia ochreous-whitish (imperfect). Underside ochreous-whitish; both wings with well-marked dark fuscous discal dots and postmedian lines, and subterminal fuscous suffusion.

Type in Coll. Lyell.

V., Sale, in March, one specimen; T., Launceston, two specimens, received from Mr. G. Lyell. These latter differ in the transverse line on hind wings, and underside being much more slightly developed, and the underside suffused with fuscous.

118. Xanthorhoe brujata.

Scotosia brujata, Gn. Lep. x., p. 444.

Scotosia repentinata, Wlk. Brit. Mus. Cat., xxv., p. 1356.

Scotosia incertata, Wlk. Brit. Mus. Cat., xxv., p. 1356.

Tephrosia breviaria, Wlk. Brit. Mus. Cat., xxxv., p. 1591.

Xanthorhoe repentinata, Meyr. P.L.S. N.S.W., 1890, p. 868.

I have no doubt that Guenée's description refers to this species. The short white line immediately following the postmedian line and beneath its projecting angle is well-marked in some specimens though often obsolete, and is very clearly referred to by Guenée. The colouration varies from a reddish-brown, with darker median band, to an almost uniform fuscous.

Q., Duaringa, Brisbane, Toowoomba, Killarney; N.S.W., Newcastle, Sydney, Blackheath, Jenolan; V., Melbourne, Gisborne.

119. Xanthorhoe anaspila.

Xanthorhoe anaspila, Meyr. P.L.S. N.S.W., 1890, p. 869.

Type in Coll. Meyrick.

N.S.W., Glen Innes, Sydney; V., Gisborne.

120. XANTHORHOE XERODES.

Xanthorhoe xerodes, Meyr. P.L.S. N.S.W., 1890, p. 870.

I have not examined the neuration of this species, and so cannot say whether it rightly belongs to this section.

Type in Coll. Meyrick.

V., Melbourne (?) (Lower); W.A., Albany, Perth.

121. XANTHORHOE HELIACARIA.

Coremia heliacaria, Gn. Lep. x., p. 420.

Xanthorhoe heliacaria, Meyr. P.L.S., N.S.W., 1890, p. 872.

V., Sale, Melbourne, Gisborne; T., Hobart; S.A., Mt. Lofty.

122. XANTHORHOE VICISSATA.

Coremia vicissata, Gn. Lep. x., p. 421, pl. ix., f. 5.

Xanthorhoe vicissata, Meyr. P.L.S. N.S.W., 1890, p. 872.

N.S.W., Bathurst; V., Melbourne, Gisborne; T., Hobart; S.A., Mt. Lofty.

Section II.—Hind wings with vein 5 from below centre of discocellular, which is angled.

123. XANTHORHOE EPICROSSA.

Xanthorhoe epicrossa, Meyr. P.L.S. N.S.W., 1890, p. 871.

Type in Coll. Meyrick.

N.S.W., Blackheath, Mt. Kosciusko; T., Deloraine, Strahan.

124. XANTHORHOE ARGODESMA.

Xanthorhoe argodesma, Meyr. P.L.S. N.S.W., 1890, p. 867.

I do not know this species and refer it to this section only conjecturally.

Type in Coll. Meyrick.

V., Melbourne, Myrtleford.

125. XANTHORHOE CHEIMATOBIATA.

Camptogramma (?) cheimatobiata, Gn. Lep. x., p. 428.

Larentia (?) extensata, Wlk. Brit. Mus. Cat., xxiv., p. 1195.

♂ ♀, 25-28 mm. Head and thorax whitish, mixed with dark fuscous. Face and palpi dark fuscous; palpi 1¼. Antennae whitish-grey; pectinations 9-10. Abdomen whitish, mixed with dark fuscous, with a double dorsal series of dark dots. Legs dark fuscous annulated with whitish; in posterior pair mostly whitish. Fore wings with costa scarcely arched, termen rounded, oblique; white; with numerous oblique slightly waved dark fuscous lines; a small, dark fuscous basal patch, followed by two or three lines; a median band, mostly fuscous; anterior margin from costa at $\frac{2}{5}$ to inner margin at $\frac{2}{5}$, nearly straight; posterior border from costa at $\frac{4}{5}$ to inner margin at $\frac{4}{5}$, nearly straight; closely followed by a fine parallel line; two well marked subterminal lines, and a well marked submarginal line, all parallel; a very distinct blackish terminal line, interrupted at veins; cilia white, with a few dark fuscous scales. Hind wings white; with four slightly waved dark fuscous transverse lines from inner margin, becoming lost in disc; subterminal, submarginal, terminal lines, and cilia as in fore wings.

Mr. Meyrick was unacquainted with this species.

T., Hobart; V., Mt. Erica (Lyell).

126. Xanthorhoe dascia, n. sp.

[δασκιος, dark].

Xanthorhoe extensata, Meyr. P.L.S. N.S.W., 1890, p. 867; *nec* Wlk., Brit. Mus. Cat., xxiv., p. 1195.

♂ ♀, 22-26 mm. Head blackish, with a few whitish scales on crown. Palpi 1¼; blackish. Thorax and abdomen blackish irrorated with whitish. Legs dark fuscous annulated with whitish; posterior pair mostly whitish. Fore wings with costa scarcely arched; termen bowed, oblique; whitish with blackish lines and median band, the dark colour preponderating; an ill-defined dark basal patch; anterior edge of median band from $\frac{1}{3}$ costa to $\frac{1}{3}$ dorsum, slightly waved; posterior edge from $\frac{2}{3}$ costa to $\frac{2}{3}$ dorsum slightly indented beneath costa, with a short obtuse median projection; followed by several fine parallel dark lines; subterminal line whitish, crenulate; an interrupted black terminal line; cilia whitish, with a blackish median line; apices

barred with dark fuscous. Hind wings with termen rounded; whitish, suffused with dark fuscous; indications of fine dark lines at inner margin; usually a broad dark fuscous terminal band containing a wavy whitish subterminal line; terminal line and cilia as fore wings.

This appears to be the species described by Meyrick as X. extensata, Wlk.; probably trusting to Walker's description for identification. I have examined Walker's type, and though it is in poor condition, I satisfied myself that it is referable to the preceding species.

Type in Coll. Lyell.

Var. petrodes [πετροδης, resembling a rock]. Fore wings grey rather than blackish, with pale ocheous-brown suffusion near base and in parts of disc.

Q., Warwick, in April. Four ♂ specimens of the variety petrodes, harmonising in colouration with the rocks on which they settled. N.S.W., Bathurst; V., Melbourne, Fernshaw, Gisborne, in March and April; four specimens received from Mr. G. Lyell. S.A., Mt. Lofty.

127. Xanthorhoe xanthospila.

Xanthorhoe xanthospila, Low. Tr.R.S. S.A., 1892, p. 13.

♂ ♀, 22-24 mm. Head whitish-ochreous, with a few fuscous scales. Face and palpi dark fuscous with a few whitish-ochreous scales; palpi 1¼. Antennae whitish-grey; pectinations 6. Thorax dark fuscous; anterior edge whitish-ochreous; patagia whitish-ochreous, with a blackish transverse line. Abdomen whitish-ochreous, mixed with fuscous; with a double dorsal series of dark dots. Legs dark fuscous annulated with ochreous-whitish; posterior pair ochreous-whitish irrorated with dark fuscous. Fore wings with costa slightly arched, termen slightly bowed, oblique; dark fuscous mixed with whitish and with ochreous on veins; basal line obscure, outwardly curved, oblique; median band darker, except in centre, which contains a blackish discal dot; anterior edge, from costa at ⅓ to inner margin at ¼, obscurely outlined with whitish, above nearly straight, beneath strongly curved inwards; posterior edge sharply defined, bounded by a double whitish line, from costa at ¾ to inner margin at ¾, with a sharp median projection, indented above and below

projection; an interrupted whitish waved subterminal line; an interrupted blackish terminal line, thickened between interruptions; cilia fuscous mixed with pale ochreous; apices whitish. Hind wings with termen slightly rounded; whitish suffused with grey; with a dark fuscous discal dot, and an interrupted dark fuscous hind marginal line; cilia whitish mixed with grey.

Type in Coll. Lower.

V., Gisborne, Kewell, Birchip; S.A., Mt. Lofty.

Genus 21. **Dasysterna**, nov.

[δασυστερνος, hairy-breasted].

Face with long projecting hairs. Tongue present. Antennae of ♂ ciliated. Palpi rather long, second joint ascending, terminal joint porrect, clothed with long stiff hairs in front. Thorax and coxae densely hairy beneath. Posterior tibae with all spurs present. Fore wings with areole single. Hind wings with vein 5 from slightly above middle of cell, 6 and 7 stalked, 8 anastomosing with cell to beyond middle.

Type D. tristis, Butl.

Closely allied to Dasyuris, Gn., of which it is a development; these two genera, with the New Zealand Notoreas, Meyr., and the New Zealand and European Lythria, Hb., form a natural and probably archaic group.

128. Dasysterna tristis.

Phytometra tristis, Butl. A.M.N.H., 1882, p. 90.

Scordylia tristis, Meyr. P.L.S. N.S.W., 1890, p. 819.

Type in British Museum.

Mr. Meyrick overlooked the hairy underside of this species; probably in his specimens it was denuded. Mr. Butler made a less excusable error in describing it as a Noctuid.

V., Melbourne, Kewell, Nhill.

Genus 22. **Dasyuris.**

Dasyuris, Gn.

Face rough-haired or with projecting scales. Palpi moderate, porrected, with long dense rough hairs. Antennae in ♂ shortly

ciliated. Thorax and coxae densely hairy beneath. Posterior tibae with all spurs present. Fore wings with areole double. Hind wings with 8 anastomosing with cell from near base to beyond middle (Meyrick).

Besides the Australian and New Zealand species there is one European.

1.	Hind wings with yellow markings - - -	2
	Hind wings without yellow markings - -	3
2.	Fore wings with postmedian line angled - -	euclidiata
	Fore wings with postmedian line not angled -	hedylepta
3.	Hind wings with postmedian line angled - -	decisaria
	Hind wings with postmedian line not angled -	caesia

129. Dasyuris decisaria.

Fidonia decisaria, Wlk. Brit. Mus. Cat., xxvi., p. 1671.
Dasyuris decisaria, Meyr. P.L.S. N.S.W., 1890, p. 875.
Type in British Museum.
V., Melbourne, Gisborne; T., Launceston, Mt. Wellington.

130. Dasyuris caesia, n. sp.

[Caesius, grey].

♀, 22 mm. Head and palpi fuscous mixed with whitish-grey; palpi $2\frac{3}{4}$. Antennae grey. Thorax and abdomen grey irrorated with whitish. Legs grey irrorated with whitish. Fore wings elongate-triangular; costa almost straight; termen strongly bowed, slightly oblique; whitish with grey markings and irroration; a transverse line near base; antemedian line well marked, outwardly curved, from $\frac{1}{3}$ costa to $\frac{2}{5}$ dorsum; a faint median shade preceded by a discal dot; postmedian line very distinct from $\frac{2}{5}$ costa to $\frac{3}{4}$ dorsum, somewhat wavy, with a slight bidentate median projection; terminal area suffusedly darker, with a fine wavy subterminal line; an interrupted dark fuscous fine terminal line; cilia grey, sharply barred with whitish. Hind wings with termen rounded; whitish-grey, with a broad dark grey terminal band; postmedian line faintly marked, not angulated; subterminal and terminal lines and cilia as fore wings.

Closely allied to D. decisaria, Wlk.; but the fore wings are narrower and much paler, the postmedian line with median

projection less marked, and the hind wings have termen not wavy, and the postmedian line not angled.

Type in Coll. Lyell.

V., Kewell, in October. One specimen taken by Mr. J. R. Hill.

131. Dasyuris euclidiata.

Coremia euclidiata, Gn. Lep. x., p. 420.

Coremia glyphicata, Gn. Lep. x., p. 420.

Dasyuris euclidiata, Meyr. P.L.S. N.S.W., 1890, p. 876.

Q., Warwick. I found this species abundant in October, flying actively in the bright sunshine, attracted by the flowers of Galium.

V., Melbourne, Gisborne.

132. Dasyuris hedylepta, n. sp.

[ἡδυληπτος, taken with pleasure].

♂ ♀, 32-36 mm. Head dark fuscous with a few whitish scales. Palpi dark fuscous mixed with ochreous-whitish, which preponderates towards base. Antennae dark fuscous; in ♂ dentate and shortly ciliated ($\frac{1}{2}$). Thorax and abdomen dark fuscous irrorated with whitish-ochreous. Legs dark fuscous mixed with ochreous-whitish; posterior pair paler. Fore wings triangular, costa slightly arched, termen moderately bowed, slightly oblique; fuscous mixed with whitish; an obscure dark transverse line near base, edged posteriorly by a whitish line; antemedian line white, twice dentate, from $\frac{1}{4}$ costa to $\frac{1}{3}$ dorsum, posteriorly edged with dark fuscous; a slightly curved dark fuscous line sometimes follows this before mid-disc; a blackish discal dot; postmedian line fine, blackish, outwardly curved, with rounded teeth, from $\frac{3}{4}$ costa to $\frac{3}{4}$ dorsum, edged posteriorly by a white line; this is sometimes preceded by a fine outwardly curved fuscous line from $\frac{2}{3}$ costa to $\frac{5}{8}$ dorsum; a fine wavy, whitish subterminal line; a fine interrupted blackish terminal line; cilia fuscous, apices barred with whitish. Hind wings with termen rounded; fuscous; basal part of disc more or less suffused with bright ochreous; a wavy bright ochreous subterminal line; terminal line scarcely traceable; cilia as in fore wings,

but at apex wholly whitish. Under surface of both wings ochreous; bases irrorated with fuscous; discal dot and postmedian line dark fuscous; suffused fuscous subterminal and terminal lines, both interrupted in middle.

Type in Coll. Lyell.

V., Mount Erica (4500 feet), in February; five specimens.

APPENDIX.

Genus 23. Cleptocosmia.

Cleptocosmia, Warr. Nov. Zool., 1896, p. 383.

Fore wings with basal half clothed with long hairs, veins 7, 8, 9, 10 and 11 stalked, no areole. Hind wings with veins 3 and 4 stalked, 6 and 7 stalked, 8 anastomosing with cell as far as middle. Hind tibiae with middle spurs absent.

I examined the neuration of the type and it is certainly very aberrant in this family, but Hampson records similar absence of the areole in several Indian genera. Perhaps the genus may be distantly related to Astheria, but further examination of more abundant material is necessary to form an opinion.

Type Cleptocosmia mutabilis, Warr.

133. Cleptocosmia mutabilis.

Cleptocosmia mutabilis, Warr. Nov. Zool., 1896, p. 383.

Type in Coll. Rothschild.

N.Q., Cooktown.

Species Unrecognised, or Not Rightly Included in this Sub-family.

134. Melanippe icterata, Gn. Lep. x., p. 387, pl. ix., f. 9. Said to be from New Holland. Mr. Meyrick believes the locality to be erroneous.

135. Coremia extraneata, Gn. Lep. x., p. 416. A species of unknown locality, conjecturally referred by the author to Australia.

136. Coremia opertaria, Gn. Lep. x., p. 421. From Australia. Unknown to me.

137. Camptogramma bichromata, Gn. Lep. x., p. 425. From Tasmania. Unknown to me.

138. Larentia (?) intenebrata, Wlk. Brit. Mus. Cat., xxiv., p. 1196. I did not see any type in the British Museum, and without a type this species cannot be safely conjectured.

139. Coremia ordinaria, Wlk. Brit. Mus. Cat., xxv., p. 1320. From Tasmania. Unknown to me. I did not see any type.

140. Phibalapteryx strixata, Wlk. Brit. Mus. Cat., xxv., p. 1341. From Sydney. I saw no type. Belongs to the genus Selidosema; cheluta, Meyr., is a synonym. (Selidoseminae).

141. Scotosia fractata, Wlk. Brit. Mus. Cat., xxv., p. 1359, is a synonym of Selidosema euboliaria, Wlk. (Selidoseminae).

142. Cidaria assimilata, Wlk. Brit. Mus. Cat., xxv., p. 1408. From Swan River. Unknown to me.

143. Panagra multifilaria, Wlk. Brit. Mus. Cat., xxvi., p. 1664. From Tasmania. According to Swinhoe (Cat. Oxf. Mus., ii., p. 356) the type is in the Oxford Museum, and is referable to the genus Asthena.

144. Melanippe teliferata, Wlk. Brit. Mus. Cat., xxvi., p. 1712, is a synonym of Satraparchis bijugata, Wlk. (Monoctenianae).

145. Scotosia metarhodata, Wlk. Brit. Mus. Cat., xxvi., p. 1724. Belongs to the genus Pseudoterpna (Geometrinae).

146. Cidaria metaxanthata, Wlk. Brit. Mus. Cat., xxvi., p. 1734, is a synonym for Dichromodes ainaria, Gn. (Monoctenianae).

147. Eubolia indicataria, Wlk. Brit. Mus. Cat., xxxv., p. 1698. Belongs to the genus Dichromodes (Monoctenianae).

148. Eubolia partitaria, Wlk. Brit. Mus. Cat., xxxv., p. 1699, also belongs to the genus Dichromodes.

149. Collix multifilata, Warr. Nov. Zool., 1896, p. 385.

150. Rhinoprora pallidiplaga, Warr. Nov. Zool., 1898, p. 25. From Duaringa. I did not identify the type, which is without hind legs, but is probably a Chloroclystis near euryzona, but with hind wings wholly fuscous.

151. Megatheca dentosa, Warr. Nov. Zool., 1901, p. 31. From Mackay. This is a Chloroclystis which I failed to

identify, allied to euryzona. Sir G. Hampson informs me that it is idential with tenuilinea, Warr., from Pulo Laut.

152. Mesoptila anthracias, Low. P.L.S. N.S.W., 1897, p. 12. This belongs to the Noctuidae, and is allied to the genus Panilla. I am indebted to Miss Wise, of Sale, for allowing me to examine the type.

153. Xanthorhoe lychnota, Low. P.L.S. N.S.W., 1900, p. 404. The type of this belongs to the Selidoseminae.

154. Epirrhoë bertha, Swin. Tr.E.S., 1902, p. 648. From Hobart. "Allied to E. scotodes, Turn." This and the following recently described species are unknown to me.

155. Epirrhoë maerens, Swin. Tr.E.S., 1902, p. 648. From Mt. Kosciusko.

156. Dasyuris tridenta, Swin. Tr.E.S., 1902, p. 649. From Geraldton, W.A.

157. Microdes arcuata, Swin. Tr.E.S., 1902, p. 652. From "S.E. Australia."

INDEX TO GENERA.

INDEX TO SPECIES.

Synonyms, unrecognised species, and species not rightly included in the sub-family in italics.

Art. XVI.—*The Auriferous Sandstones of Chiltern.*

By E. J. Dunn, F.G.S.

[Read 12th November, 1903].

In 1858 Conness and party discovered the goldfield that surrounds the present town of Chiltern. Their shaft was sunk near the N.W. corner of the block of land marked Bigbey (Allotment G, Sec. A, Parish of Chiltern), and the sample of gold obtained from the bottom was seen by the writer on its way to Beechworth, where the reward was claimed. Within a few weeks there were about 25,000 people at the Indigo Rush, and a township extended for four miles along the course of Indigo Lead.

Chiltern is 168½ miles from Melbourne, on the North-Eastern railway, and the position of the Caledonian Lead—a branch of the Indigo Lead, where auriferous sandstone occurs—is 3 miles N.W. in a straight line from Chiltern and about 2 miles due S. from Mount Pleasant.

Portion of the Caledonian Lead was worked by Mr. Barrass, Senr., and party, and more than twenty years ago Mr. Barrass discovered that some of the sandstone pebbles and boulders in the wash-dirt were auriferous. Forty or fifty loads were gathered up and crushed at an ordinary battery for a return of 15 to 20 dwt. of gold per load; this was only a fraction of the gold contained in the pebbles, as the gold is too fine for treatment in the ordinary stamp battery. Twelve loads more were obtained by this party on the surface at the Devonshire Lead, but whether they were obtained from that lead or had been carted over from the Caledonian Lead is uncertain. Altogether, probably, from 90 to 100 loads of these pebbles have been gathered up and treated for gold.

Auriferous pebbles were met with in the gravel of the lead from where the Caledonian Lead crossed the Devonshire Reef, and for about 400 feet down the course of the lead below the intersection. No auriferous sandstone pebbles were found in the

branch lead from the south, which joins the Caledonian Lead 2 chains above where the Devonshire Reef crosses it, nor were any found further up the lead, until within 100 feet of the Caledonian Reef. Where this reef crosses the Caledonian Lead and for 100 feet below the intersection, they were again met with.

These pebbles were so rich in gold that an effort was made to locate the beds of rock from which they had been derived. Messrs. Barrass and party expended much work in the search. They sank a shaft 135 feet through the alluvium on to a slate bar carrying gold, and then trenched the bed-rock below the lead for 300 to 400 feet below where the Devonshire Reef is crossed. The slate bar was 9 feet wide, and it carried by assay about 3 dwts. of gold per ton. This was sunk into for 20 feet, when the gold apparently ceased. This bar was not far from the reef. Westward the trenching did not disclose auriferous sandstone, but in a shaft sunk a little to the east of the other one, sandstone was found carrying gold. A few loads were crushed, and several loads dumped on the surface that yield a small prospect of microscopic crystalline gold.

More recent efforts to locate the source of the auriferous sandstone pebbles were made by Mr. J. Moore and others, where the Caledonian Lead crosses the Caledonian Reef. A shaft was sunk on the reef through 90 feet of alluvium, and near this nodular sandstone was cut carrying a little gold, and by trenching into the floor of the lead other bands of sandstones were cut carrying a little gold. A few loads yielded 14 dwts. per load, as I am informed by Messrs. H. Williams and Snow, who worked at this site, and who kindly supplied the information concerning it. In no case could the gold be traced more than 6 or 7 feet into the rock forming the floor of the lead. Another shaft was sunk 200 feet further east, but nothing obtained to encourage further outlay.

In 1887 Mr. Barrass, Senr., showed the auriferous sandstones to the writer, and from examples found by the latter, and assayed at the Mining Department, results up to and exceeding 20 oz. per ton were obtained. The boulders and pebbles are more or less rounded, and some show a nodular structure. They are generally white or grey on the outside, and yellowish-brown

from ferruginous stain inside. In size they range from a nutmeg to that of a man's head. Particles of gold are frequently visible on a fresh fracture to the naked eye, for the planes of these minute crystalline particles are highly polished, and reflect the light well. The pebbles are of varying degrees of coarseness; they are very porous, and are seen to consist of more or less rounded quartz grains with numerous small cavities between, and in these cavities is a ferruginous substance, and on this the particles of gold occur.

By crushing and panning-off these pebbles yield a "tail" of fine gold that is heavy and "hangs well" in the spoon or dish, but the particles are so microscopically fine that once they become dry they float away on the surface of the water. This gold is of good colour and high degree of fineness, and consists of small crystals that sparkle in the light. This distinctive character of the gold holds good both for the loose rounded pebbles of sandstone found in the gravel, and also for that found in the bed-rock below.

Last month the writer re-visited the locality with the object of arriving at some definite conclusion, and was fortunate enough to find a specimen which is the key to the whole matter. This is a pebble of slate $4\frac{1}{2}$ in. long, $1\frac{1}{2}$ in. wide, and $1\frac{1}{4}$ in. thick, and boat shaped. It was found about 400 feet lower down the lead than where the Devonshire Reef is crossed. It was split into two portions along a cleavage plane. One side is thickly spangled with crystalline dots of gold on the cleavage plane, and the cleavage plane of the other side has a few spangles of gold also. A margin around the edge of the plane with the most gold on it is bare of gold, showing that the pebble had the gold deposited upon it after it was formed into a pebble, and while it was in the gravel of the lead; and this shows that solutions containing gold must have traversed the lead, and where the conditions were suitable this gold was deposited in more or less crystalline form. Just as the gold was deposited in the slate pebble, so, no doubt, it was also deposited in the sandstone pebbles while they were in the gravel of the lead. By means of such a solution the slate rocks and sandstones forming the floor of the Caledonian Lead could also be impregnated with gold to a greater or lesser depth below the floor of the lead. To further check the matter the soil on

the ridges below both the Caledonian and Devonshire Reefs was carefully panned from a great many places, but not a particle of such crystalline gold as characterises both the pebbles and the bed-rock in the lead could be discovered.

It is necessary here to understand the physical conditions existing in the locality. The Caledonian Lead represents an old watercourse that flowed along the bottom of a valley, which has since become filled up with alluvial matter to a depth of 90 to 135 feet above the old water course, and this alluvial ground is, at the surface, from 10 to 30 chains across. North and south of the valley are spurs of Ordovician rock, and the floor of the valley is the same rock. Cutting through these rocks in a north-westerly direction and crossing through the valley from side to side are the Caledonian and Devonshire Reefs. On each side of the valley the spurs rise for from 100 to 200 feet above the present surface of the alluvial flat.

Rain falling on the spurs percolates through the sandstones and slates, dissolving alkalies and other matters, and finds its freest channel along the course of quartz-lodes, such as the Caledonian and Devonshire, and this water, after traversing such auriferous lodes through a depth of 200 or 300 feet, is discharged into the lead drainage where the reefs are crossed. During its passage through the gold-bearing quartz and accompanying sulphides it dissolved some of the gold, and where it flows into the lead re-deposited the gold in the porous sandstone pebbles and in the rocks forming the floor of the lead, where the conditions were favourable.

The Caledonian Lead is practically dry in the summer season, as the Indigo Lead drains the water away from it; but in the winter the rains percolate through the rocks and through the alluvium, and then water flows down its course, percolating through the pebbles, etc., and in this manner depositing gold. Doubtless the water contained but a very small amount of gold, and the process of deposition in the pebbles and bed-rock was a very slow one. Very probably it was also a process continued to the time the lead was worked, and even may now be active.

Auriferous pebbles also occur in other localities on this field. The writer obtained examples on the Indigo Lead, above its junction with Wallace's Gully Lead, and also in the last but one north branch on the west side of Wallace's Gully Lead.

As these sandstone pebbles carrying gold are not derived from beds of auriferous sandstone, the quest for the latter can be dropped; but the facts disclosed bear very distinctly on the problems of the enrichment and impoverishment of auriferous lodes above water level, also on the presence of gold in solution in the waters of alluvial leads.

In the early days of quartz mining in this State it was a common circumstance to find at and near the surface that the joints and faces of the quartz were coated with extremely thin films of gold. Such films were no doubt formed from solutions that had previously dissolved some of the gold out of the adjacent stone. The term "New Chum Gold" was applied to such occurrences, because inexperienced miners were apt to over-estimate the value of such finds. Paint-gold was another name applied to such occurrences.

In most auriferous quartz lodes the ore above permanent water level differs entirely in nature from that below water level. Below water level the ore is as originally formed, and consists of quartz and other gaugue and metallic minerals in the form of sulphides, except the gold, which is in metallic form, the so called refractory ores. Such ores are due to deposition from the lower circulating waters, which have brought them up from deeper levels.

Above the permanent water lines the ores met with have resulted from the de-sulphurising and oxidising of these sulphide ores, through the agency of rain and air, which obtain access to the lode-material.

To the upper zone of auriferous lodes the term "zone of enrichment" has been applied in many cases. This is an apt definition, for enrichment of the surface and to shallow depths of such lodes has frequently taken place, and in one of the following ways:—

First.—Mechanically, where the crumbling away of the gold matrix has set the metal free and allowed it to drop near the outcrop of the lode. Innumerable examples of such enrichments near the cap of the lode were met with in Victoria, in all the Australian States, and in South Africa.

Phenomenal yields were common in Victoria at and near the outcrop, and for a short distance down, or as far as the quartz

was "rubbly." When solid ground was reached there was often a sudden and serious dwindling of the yields. In such cases the gold about the out-crop might represent the contents of many feet of the lode above the present surface of the ground.

Secondly.—Chemically, by the action of rain-water percolating through the strata and draining into the lodes and along them, as the easiest course, to lower levels. Such waters and the air acted on the sulphides, decomposing them, and in turn charged with the products of decomposition dissolved some of the gold, and bore it away to some other portion of the lode where the conditions were favourable, and there the gold was re-deposited. In this way some lodes have become enriched in their lower levels by gold brought in solution from the higher levels.

Rich ore has often been found in quartz reefs just above water level. From the appearance of the gold in the quartz in many cases enrichment might be inferred, for the gold appears to have pushed the quartz apart as it increased in bulk in the cracks and fissures until the stone has a crushed appearance. Cases of this have been observed at Maldon, Sitlington's Mystery Reef, near Elaine, at Tangil and elsewhere. That gold was deposited subsequent to the deposition of the quartz in some cases is fully proved by instances that the writer met with in West Australia. A nugget weighing over 90 ozs. was seen that had evidently been formed in a cavity lined with quartz crystals, for it retained sharp hollow casts in its substance of quartz crystal pyramids.

For the self-same reason that portions of auriferous quartz-lodes above the water level may become enriched by gold removed from some other portion of the same lode, the portion of the lode above water level may, and does, often represent a zone of impoverishment. This must be the case at the Caledonian Lead, where gold dissolved from the Caledonian and Devonshire Reefs finds its way into the channel of the Devonian Lead.

Cases are common in Victoria where highly auriferous lodes are cut across by a fault, and beyond the fault the lode is barren, or nearly so. In such cases one explanation may be that the fracture has opened a means of surface drainage by which the gold has been leached out of the barren sections of the lode.

On the lateral secretion theory of lodes the Caledonian Lead occurrence has also a bearing, for where the walls of lodes or the

country rock containing the lodes are found to carry some proportion of the same minerals as abound in the lode itself, may these not have been derived from the lode, instead of the other way about? In very many cases it has been noticed that country rock close to unusually rich portions of a reef is also auriferous. At the Mystery Reef, Elaine, this was the case; the soft, yellow, decomposed slate carrying several dwts. of gold to the ton.

Where gold occurs in sandstone and in slate in these States it may generally be considered as of secondary origin; it is usually not constant for any great distance.

The crystallized gold, often found where indicators of slate are crossed by quartz veins and generally at the site of some displacement of the strata, is certainly of secondary character, and has accreted at these particular sites from solutions that have leached the gold out at some higher level. To such origin, also, must be attributed the rich leaders at Elaine and elsewhere.

It is evident that the percolation of surface waters through auriferous lodes that dissolve gold, and carry it away in solution through other parts of these lodes, and that also drain into the channels of alluvial leads and flow down them, is still in action, and has to be considered as an agency at work both in the lodes and in alluvial leads.

If such waters could deposit gold in the planes of a slate pebble, and in the small cavities of sandstone pebbles, there seems no valid reason why some should not be deposited on the particles of gold in the leads also. Examples showing such to be the case have not been met with by the writer, though the possibility was demonstrated long ago by the late Mr. C. S. Wilkinson. For the data concerning work done, etc., my acknowledgments are due to Mr. Barrass, Senr., one of our veteran miners, and also to Messrs. Snow and H. Williams, of Mount Pleasant.

Art. XVII.—*The Geology of the Barwon about Inverleigh.*

By T. S. HALL, M.A., and G. B. PRITCHARD.

(With Plate XXVI.).

[Read 12th November, 1903.]

Any references to the geology of the Barwon Valley between its junction with the Leigh and the Moorabool are but scanty. In 1889 we paid a brief visit to the junction of Native Hut Creek with the Barwon, and collected a few fossils, which were included in a Catalogue of Tertiary Fossils published by one of us in 1892 (1). A couple of years later the same author described Pinna cordata from near the same locality (2). In 1898 Messrs. Dennant and Mulder noted the occurrence of eocene clays at Inverleigh without, however, recording any fossils, and concluded that the deposit was continuous from that place northwards to the sections described by them about Shelford.

The general geological boundaries are shown on Everett's map, with perhaps as much exactness as the scale would allow, and are, as we understand from Mr. H. Herman, the result of a very hurried visit.

The township of Inverleigh is situated at the junction of the Leigh and the Barwon on an alluvial tongue in the broad valley cut by the two streams. To the west, south, and east the surface rocks are mainly basaltic, while to the north is a sandy plateau covered with the usual park-like growth of eucalyptus that this class of country generally supports in Southern Victoria. The surface of the lava plain drops rapidly from the northwards towards the foot of the Barrabool Hills, Elaine, twenty-two miles to the north, being 1300 feet above sea level, while the basalt escarpment west of Inverleigh is about 200 feet. From Inverleigh to Pollocksford the Barwon for the most part cuts its way through the lava to the underlying tertiaries, though about the junction of Native Hut and Bruce's Creeks it follows the

boundary between the basalt and the tertiary inliers to the north, which have never been covered by the flows. From Pollocksford to the junction of the Moorabool at Fyansford the river marks the geological boundary between basalt to the north, and the jurassic sandstones and other rocks, forming the Barrabool Hills, to the south.

Messrs. Dennant and Mulder have described the marine tertiary and associated beds of the Leigh in the paper quoted above, and have recognized about Shelford the occurrence of two sets of marine beds belonging to what they called eocene and miocene, and which we have suggested should be named Balcombian and Kalimnan. From a short distance above Shelford down to Inverleigh the left bank of the Leigh is bordered by a sandy plateau. The sands are in places cemented by iron oxide in their upper parts, and are succeeded in depth by slightly more argillaceous beds. On the opposite bank of the valley the upper beds have yielded Kalimnan fossils, and the lower ones Balcombian, and it seems probable that the same state of things should prevail on the left side of the valley, and that both sets of beds should be present, but the hill slopes are grass-covered for the most part and no Kalimnan fossils have been found as far as we are aware. The lower beds, where exposed, have yielded Balcombian forms; the most southerly, recorded by Messrs. Dennant and Mulder, being at "Farrell's" (Section 44, Parish of Carrah). Wherever the beds are exposed near river level, from here to Inverleigh, Balcombian fossils may be found, and were it not that Kalimnan species are yielded abundantly near Shelford, no hesitation would be felt in describing the whole inlier as Balcombian. The probability, however, is, as already indicated by Messrs. Dennant and Mulder, that there is a Kalimnan cover. On the eastern side of this area, where the Shelford road drops down into the Native Hut Creek Valley, the beds are very ferruginous, and we spent some hours searching in vain for fossils. Nor did we find any evidence one way or the other along the bush track from Teesdale to Shelford, while the deep road cutting, leading from the plateau to the Leigh Bridge higher up the valley than Inverleigh, was equally barren of result. We are, however, of the opinion, as already stated, that the superficial portion of the series should be regarded as Kalimnan, though fossil evidence is wanting.

The road from Shelford to Leigh Road (Bannockburn) traverses these sandy beds for the whole of its twelve miles of length, with the exception of a small patch of basalt at Teesdale, and a narrow flow, about a quarter of a mile wide, which passes down Stony Creek. To the southward this flow is continuous with that at the Inverleigh Racecourse, the low bluffs on the river bank east of Inverleigh, and so on across the Barwon south of this, till it merges in the wide basaltic area about the foot of Mount Pollock and the sandy plateau of Gnarwarre.

The sandy beds to the east of Stony Creek on the Teesdale-Bannockburn Road, are marked as younger tertiary on Everett's map; but there seems no good reason for the different colouration on the two sides of the Stony Creek coulée. This flow is only a very thin one where the Teesdale to Bannockburn Road crosses it, as evidenced by the fact that it usually supports a similar growth of trees to that which the sandy beds do, or, in other words, the roots pierce the basalt to reach the sands below. Besides this there are several bracken-covered patches of sand which rise slightly above the basalt which surrounds them. So far no fossil evidence of the Kalimnan age of the upper part of these beds has been found, though we have searched near Bannockburn and Murgheboluc. The underlying beds yield a Balcombian fauna at Murgheboluc and Native Hut Creek, as will be shown in the sequel; but we believe the superficial beds to belong to the younger series, though, it must be admitted, on very slight evidence.

The present paper deals more particularly with the sections of the Balcombian beds displayed along the course of the Barwon from Inverleigh to Pollocksford. These occur on the faces of the gorge cut by the stream, and are not indicated on Everett's map, with the exception of the one below Murgheboluc. Even had they been noticed the small scale of the map would have prevented their indication.

Inverleigh.

For about a mile and a half above the bridge on the main road the river flows close along the foot of the plateau to the north of the township, with the result that numerous small outcrops of

Balcombian beds occur close to water level. A couple of hundred yards or so above the bridge there is a good exposure along the river, which can only be worked when the water is about summer level. There is another exposure at about the same distance below the bridge. As in all the outcrops about here the beds are practically horizontal, we have not kept the fossils separate. The strata consist of light grey sandy clays, and the fossils are in a good state of preservation. Among the more interesting finds were several specimens of Poroleda lanceolata, hitherto known only from the Gellibrand and Grice's Creek.

From the bridge for about a mile to the south-east the Leigh and the Barwon, which unites with it, meander through sandy alluvial flats, and then plunge into a shallow gorge about forty feet deep, cut into basalt, which occupies the river bed. A succession of rapids follows for a mile and a quarter when another alluvial flat is met, where the river receives the Native Hut Creek coming down from the north.

NATIVE HUT CREEK.

There is a fair exposure at the junction of the two streams, and a much better one about a mile and a half up the creek. At this upper section the beds are again sandy, with sheets of sandy limestone a few feet in thickness interstratified, and becoming ferruginous as we ascend. There is a considerable amount of salt in the beds, and brackish springs or soakages occur at various points, and the fossils are apt to become destroyed by efflorescing salt, unless washed immediately after collection.

A fine tooth of Carcharodon megalodon, five and a quarter inches in height, was obtained here, as well as a large nautilus, eight inches in diameter, and Cypraea gigas. Fragments of large shells are not uncommon, but fossils are only sparingly scattered through the sandy matrix. Pinna cordata, Prit., came from the junction of Native Hut Creek and the Barwon.

After the confluence of the two streams the Barwon turns sharply to the south, and describes a U-shaped loop about three miles in length. There are a few exposures apparently of Balcombian beds beneath the basalt cover, but we saw no fossils. At the road marked between Allotments 20A and 20B,

Parish of Gnarwarre, the basalt comes down to river level, and about 200 yards below this columnar basalt occupies the stream bed. Near the western boundary of Allotment 21 a short gully comes in from the south, and has brought down a small amount of coarse quartz conglomerate, derived apparently from some beds underlying the basalt. Soon after this the river skirts high bank in Sections II.A and II.B of Murgheboluc, and good exposures are displayed.

MURGHEBOLUC II.B.

Close to the junction of Allotments II.A and II.B we find at river level five feet of grey clays passing up into fawn sandy clays, and then into sands. There are several concretionary limestone bands present, some of which are rich in foraminifera, and might almost be called Operculina limestone, so plentiful are examples of this genus. The cliff is about 70 or 80 feet high, and is capped by basalt. The base of the cliff is somewhat masked by fallen debris, but a few yards further on the river runs close past its foot, and an easily worked section is exposed.

The beds as a whole resemble the others described, being grey sandy clays, with well preserved fossils in its lower part, though they have disappeared higher up the bank. There is an area of about 200 acres on the right bank of the river, from which the basalt has been denuded, and the boundary between the sandy older tertiary and the alluvium cannot be clearly drawn.

From here to the Murgheboluc flat we noted only a couple of exposures; one at river level in Section III., A and B, of Murgheboluc, seemed fairly rich, and we saw Cypraea eximia, and a few other typical forms. The river now touches the southern border of what we may call the Bruce's Creek tertiary area, which extends from here northward to about Lethbridge, the probable age of the superfical beds of which we have previously alluded to. A large amount of denudation has taken place, and on the northern or left bank of the river there is nearly a square mile of alluvial flat intersected by a few deserted river channels, and there is a smaller similar area on the south side of the stream. The whole quadrangular area is hemmed by steep cliffs about 100 feet in height, the river entering and leaving by comparatively narrow gorges at the two southern angles.

BRUCE'S CREEK JUNCTION.

A good section is displayed on the river bank in Section IV. A, Murgheboluc. The composition of the beds, as before, is grey, sandy clays, and a fair number of fossils were obtained, including a tooth of Cestracion, n.sp., and, as is usual in sandy beds, the fossils have disappeared from the higher parts of the cliffs.

From here to Pollocksford, a little over two and a half miles in a straight line, the river gorge is narrow, and its sides are masked by basalt from the plateau above. Here and there indications of the underlying tertiaries are to be seen in places; but, even where sandy cliffs occur under the basalt, as in Section IV. C, which is inaccessible, or in Section V. B, no fossils were obtained. Just above Pollocksford an outcrop of yellow sandy clay was found, forty-five feet above the river level, and then, a hundred yards below this, columnar-basalt occupies the river bed for nearly half a mile.

Between Pollocksford and Fyansford the river skirts the jurassics, which rise to over 400 feet to the south, and is hemmed in on the north by basalt. We defer any discussion of this part of the country to a later paper.

THE AGE OF THE MARINE BEDS (Barwonian Series).

An examination of the lists of fossils given shows that the beds examined from Inverleigh to Murgheboluc are almost identical with those of Red Hill, near Shelford, and of Orphanage Hill, Fyansford. Lithologically the whole series, from Red Hill and thence down the Barwon through Inverleigh, Murgheboluc and so on to Fyansford (Orphanage Hill), are very similar, though at the latter place there is far less sand, and the beds are really grey marls.

In the paper in which we proposed the names Balcombian and Janjukian we indicated the existence of certain beds which undoubtedly belonged to the older series comprised under these two names, which are clearly distinct from the younger Kalimnan, but which from the smallness of the collections available, we did not care to refer definitely to either Balcombian or Janjukian. In other words, the palaeontological differences between Balcombian and Janjukian series, though of importance, are not

nearly so marked as between them and the Kalimnan. On these grounds we think it advisable that a name should be given which will comprise both Balcombian and Janjukian. The former series is extensively developed in the Barwon basin, and the latter at its typical exposure at Spring Creek, south of Geelong, is not far from the borders of the same basin, so that the name Barwonian is suggested.

No geographical name that can be proposed is of course free from objection on the grounds that other beds are present in the area taken as typical; but it seems advisable that a local name should be employed, and the present seems a satisfactory one.

The Basalt Plains.

There are no points of eruption in the immediate neighbourhood which can be pointed to as the probable sources of the thin, but wide-reaching, lava flows of the plains. Mount Pollock, a few miles south of Inverleigh, is merely a lava-capped outlier, a fact which Everett's map seems to indicate, for it is not marked as a point of eruption. We hope at some future time to discuss the characters of the country about here which are not made clear by our preliminary examinations. The river course when crossing the lava-covered plains is usually trenched to a depth of about 100 feet about Murgheboluc, but about Native Hut Creek and on the Barwon above Inverleigh the depth is less. Owing to constant masking of the steep slopes by basaltic soil, the thickness of the flows is rarely determinable with exactness, but as shown by the frequent presence of basalt *in situ* in the river bed, and at others by the outcrop of sandy beds at a high level, the old surface was very uneven.

The boundaries of the basalt are roughly shown on Everett's map.

The Younger Beds.

Apart from the alluvium of the present valleys there is a series of extensive sheets of sands and gravels which in many places overlie the basalt. The country between Winchelsea and Inverleigh is shown on Everett's map as covered by a uniform basalt sheet, whereas, between the outlier known as Mount

Pollock and the river Barwon on the west, the country is covered with quartz sand, which on some of the river cliffs is seen to be about thirty feet in thickness, reposing on basalt, into which the river has cut its way for another thirty feet. One travels for miles along the Winchelsea Road without seeing a stone wall, and as the plains are devoid of timber, stone would have been used did it outcrop. Following this sandy country to the northward, we find it on the left bank of the Barwon also, between Inverleigh and Native Hut Creek, extending from the river itself northwards beyond the Geelong Road. On the east of Native Hut Creek a strip about twenty feet in thickness and half a mile in length from north to south is crossed by the main road. Evidence of its former extension to the eastward is afforded by scattered quartz pebbles on the basalt plateau east of Murgheboluc. Here the material is evidently derived from the sandy tertiaries north of the Barwon, which were not covered by the flows of lava, and which in many places still rise above its level. In the neighbourhood of Inverleigh itself it is at times impossible to separate this deposit from the sandy alluvium of the river flats and the Balcombian beds, which are also sandy. We think it better to regard the ground on which Inverleigh is built as alluvium rather than as Balcombian, as some of the river cliff sections show very characteristic, thin, irregularly bedded structure quite distinct from the even bedding of the marine beds.

Some of the hillocks west of the township which gradually rise to the level of the basalt of the western plains are doubtless Balcombian, for it underlies the whole district between the ordovician on the north, and the jurassic on the south. The high level alluvium on the basalt points probably to a time when the drainage system was different from what it is now, and when the Barwon and the Leigh possibly found their way to the sea by passing along the south side of the Barrabools, the flow along the long reach of the Barwon south of Inverleigh, and reaching to near Winchelsea, being reversed.

List of Fossils.

Name of Fossil.	Inverleigh.	Native Hut Creek.	Murgheboluc.	Barwon R. Bruce's Creek Junction.
	1	2	3	4
Lamellibranchiata.				
Ostrea hyotis, Linnaeus	.	2	?3	?4
Dimya dissimilis, Tate	1	2	3	4
Pecten murrayanus, Tate	.	2	.	4
„ foulcheri, T. Woods	.	2	.	.
„ eyrei, Tate	1	.	.	4
„ sturtianus, Tate	.	2	3	4
„ yahliensis, T. Woods	.	.	.	4
Amussium zitteli, Hutton	1	2	.	4
Hinnites corioensis, McCoy	.	.	.	4
Lima bassi, T. Woods	1	.	3	4
„ linguliformis, Tate	.	.	.	4
Limatula jeffreysiana, Tate	1	.	3	4
Limea transenna, Tate	.	.	3	.
Spondylus pseudoradula, McCoy	1	2	3	4
Meleagrina crassicardia, Tate	.	.	3	4
Pinna cordata, Pritchard	.	2	.	4
Septifer fenestratus, Tate	1	2	3	4
Modiolaria balcombei, Pritchard	1	.	.	.
Nucula tenisoni, Pritchard	1	2	3	4
„ atkinsoni, Johnston	1	2	.	4
Leda vagans, Tate	1	2	3	4
„ huttoni, T. Woods	.	2	.	.
„ apiculata, Tate	1	.	3	4
„ praelonga, Tate	1	.	.	.
Sarepta obolella, Tate	1	2	3	4
Poroleda lanceolata, Tate	1	.	.	4
Limopsis belcheri, Adams and Reeve	1	2	3	4
„ morningtonensis, Pritchard	1	.	.	.
Glycimeris maccoyi, Johnston	1	2	3	4
Barbatia celleporacea, Tate	1	2	.	4
„ crustata, Tate	1	2	3	.
Plagiarca cainozoica, Tate	1	2	3	4
Cucullaea corioensis, McCoy	1	2	.	4
Trigonia tubulifera, Tate	1	2	.	.
Crassatellites communis, Tate	1	2	3	4
„ dennanti, Tate	.	.	.	4
Cardita polynema, Tate	1	2	3	4
„ delicatula, Tate	1	2	3	4
„ scabrosa, Tate	.	2	.	4
Chama lamellifera, T. Woods	1	2	3	4
Cardium cuculloides, Tate	.	.	.	4
Protocardium hemimeris, Tate	1	2	3	4
„ antisemigranulatum, McCoy	.	2	.	.

LIST OF FOSSILS (*continued*).

Name of Fossil.	Inverleigh.	Native Hut Creek.	Murgheboluc.	Barwon R. Bruce's Creek Junction.
	1	2	3	4
Chione cainozoica, T. Woods - -	1	2	3	4
„ dimorphophylla, Tate -	.	.	.	4
Meretrix eburnea, Tate - -	1	2	3	4
Dosinia densilineata, Pritchard -	1	.	.	.
Tellina cainozoica, T. Woods- -	1	?2	.	4
Semele krauseana, Tate - -	1	.	3	4
Myodora tenuilirata, Tate - -	1	2	3	.
Capistrocardia fragilis, Tate - -	1	.	.	.
Corbula ephamilla, Tate - -	1	2	.	4
„ pixidata, Tate - -	1	2	3	4
astropoda.				
Murex lophoessus, Tate - -	1	2	3	4
„ rhysus, Tate - - -	1	2	.	.
„ velificus, Tate - - -	1	2	3	4
„ eyrei, Tate - - -	1	.	3	4
„ basicinctus, Tate - -	.	.	3	4
Typhis acanthopterus, Tate - -	1	2	3	4
„ evaricosus, Tate - -	1	.	.	.
Trophon asperulus, Tate - -	.	2	3	4
Rapana aculeata, Tate - -	.	.	.	4
Argobuccinum maccoyi, Pritchard -	1	2	3	4
Lotorium woodsi, Tate - -	1	2	3	4
„ cyphus, Tate - -	1	.	.	4
„ tortirostre, Tate - -	1	2	.	.
„ pratti, T. Woods - -	.	2	.	.
„ tumulosum, Tate - -	.	.	3	.
„ protensum, Tate - -	.	.	.	4
„ annectans, Tate - -	.	.	.	4
Fusus senticosus, Tate - -	1	.	3	4
„ simulans, Tate - -	.	2	.	.
Latirofusus hexagonalis, Tate -	1	.	.	4
„ exilis, Tate - -	1	2	.	4
Clavella bulbodes, Tate - -	.	2	3	4
Siphonalia longirostris, Tate -	1	.	.	.
„ tatei, Cossmann - -	1	.	.	.
Solutofusus carinatus, Pritchard -	.	2	.	.
Fasciolaria cryptoploca, Tate -	1	.	3	4
„ cristata, Tate - -	.	2	.	4
Latirus interlineatus, Tate - -	1	2	.	.
„ succinctus, T. Woods -	.	2	3	4
„ subundulosus, Tate - -	.	2	3	4
Euthria ino, T. Woods - -	1	2	3	4
Phos tardicrescens, Tate - -	1	.	3	.
Loxotaphrus variciferus, Tate -	.	.	3	4

List of Fossils (*continued*).

Name of Fossil.	Inverleigh.	Native Hut Creek.	Murgheboluc.	Barwon R. Bruce's Creek Junction.
	1	2	3	4
Nassa tatei, T. Woods	.	2	.	.
Voluta hannafordi, McCoy	1	2	.	4
„ antiscalaris, McCoy	1	2	3	4
„ strophodon, McCoy	.	2	3	4
„ ancilloides, Tate	1	.	3	4
„ maccoyi, T. Woods	1	.	.	.
„ costellifera, Tate	1	.	.	4
„ weldii, T. Woods	1	.	.	.
Volutoconus conoidea, Tate	1	.	.	?4
Lyria harpularia, Tate	.	2	.	4
Mitra alokiza, T. Woods	1	2	.	.
„ leptalaea, Tate	1	2	.	.
„ atractoides, Tate	1	2	.	4
„ othone, T. Woods	.	2	.	.
„ ligata, Tate	.	2	3	.
Marginella propinqua, Tate	1	2	3	4
„ micula, Tate	1	2	.	.
„ inermis, Tate	1	.	.	.
„ wentworthi, T. Woods	.	2	3	.
„ septemplicata, Tate	.	2	.	.
Ancilla semilaevis, T. Woods	1	.	3	.
„ pseudaustralis, Tate	.	.	.	4
Harpa spirata, Tate	1	.	.	.
Columbella funiculata, T. Woods	.	2	.	.
Cancellaria varicifera, T. Woods	1	2	3	4
„ gradata, Tate	.	2	.	.
Terebra leptospira, Tate	?1	.	.	4
Columbarium acanthostephes, Tate	1	2	.	4
„ craspedotum, Tate	.	2	.	4
„ foliaceum, Tate	1	2	.	4
Pleurotoma murndaliana, T. Woods	1	2	3	4
„ trilirata, Harris	1	2	.	4
„ septemlirata, Harris	.	2	3	4
„ optata, Harris	1	2	.	.
„ clarae, T. Woods	.	2	3	.
Bathytoma rhomboidalis, T. Woods	1	2	3	4
Drillia oblongula, Harris	.	.	3	.
Clathurella bidens, T. Woods	1	.	.	4
Buchozia hemiothone, T. Woods	1	2	3	.
Bela sculptilis, Tate	1	.	.	4
Conus dennanti, Tate	1	2	.	4
„ heterospira, Tate	.	2	.	4
„ cuspidatus, Tate	1	2	.	4
„ ligatus, Tate	.	2	.	.
„ ptychodermis, Tate	.	2	.	.

LIST OF FOSSILS (*continued*).

Name of Fossil.	Inverleigh.	Native Hut Creek.	Murgheboluc.	Barwon R. Bruce's Creek Junction.
	1	2	3	4
Cypraea gigas, McCoy - -	1	2	.	4
„ eximia, Sowerby - -	1	2	.	4
„ contusa, McCoy - -	1	2	.	4
„ leptorhyncha, McCoy -	1	2	.	4
„ brachypyga, Tate - -	1	.	.	.
„ pyrulata, Tate - -	1	.	3	4
„ sphaerodoma var., Tate -	.	.	.	4
Trivia avellanoides, McCoy - -	1	2	3	4
Cassis exigua, T. Woods - -	1	.	.	.
Cassidea sufflata, T. Woods - -	.	2	3	.
Morio gradata, Tate - - -	.	2	.	4
Natica hamiltonensis, T. Woods -	1	2	3	4
„ polita, T. Woods - -	1	2	3	4
„ subnoae, Tate - - -	1	2	3	.
Crepidula unguiformis, Lamarck -	.	.	3	.
Xenophora tatei, Harris - -	1	2	3	4
Solarium acutum, T. Woods - -	.	2	.	.
Scala pleiophylla, Tate - -	.	2	.	.
Turritella platyspira, Tate - -	1	2	3	4
„ acricula, Tate - -	1	2	3	4
„ murrayana, Tate - -	.	.	.	4
„ tristira, Tate - -	.	2	.	.
Tenagodes occlusus, T. Woods -	1	2	3	4
Thylacodes conohelix, T. Woods -	.	2	.	.
Eulima danae, T. Woods - -	1	.	3	4
Niso psila, T. Woods - - -	.	2	3	.
Mathilda transenna, T. Woods -	1	2	.	.
Cerithium apheles, T. Woods -	1	2	3	4
Newtoniella cribarioides, T. Woods -	1	2	.	4
Triforis wilkinsoni, T. Woods -	1	2	.	.
„ planata, T. Woods -	.	2	.	4
„ sulcata, T. Woods -	.	2	.	.
Collonia parvula, T. Woods - -	.	2	.	.
Fissurellidaea malleata, Tate -	.	2	3	4
Subemarginula occlusa, Harris -	1	2	3	4
Emarginula wannonensis, Harris -	1	.	3	.
Scaphander tenuis, Harris - -	1	.	.	4
Bulinella exigua, T. Woods - -	1	.	.	.
„ aratula, Cossmann - -	1	2	3	4
„ cuneopsis, Cossmann -	1	.	3	.
Actaeon distinguendus, Cossmann -	.	2	.	.
Umbraculum australe, Harris -	.	.	3	.
Dentalium aratum, Tate - -	1	2	.	.
„ mantelli, Zittel - -	1	2	3	4
„ subfissura, Tate - -	1	2	3	4
Vaginella eligmostoma, Tate -	.	2	.	.

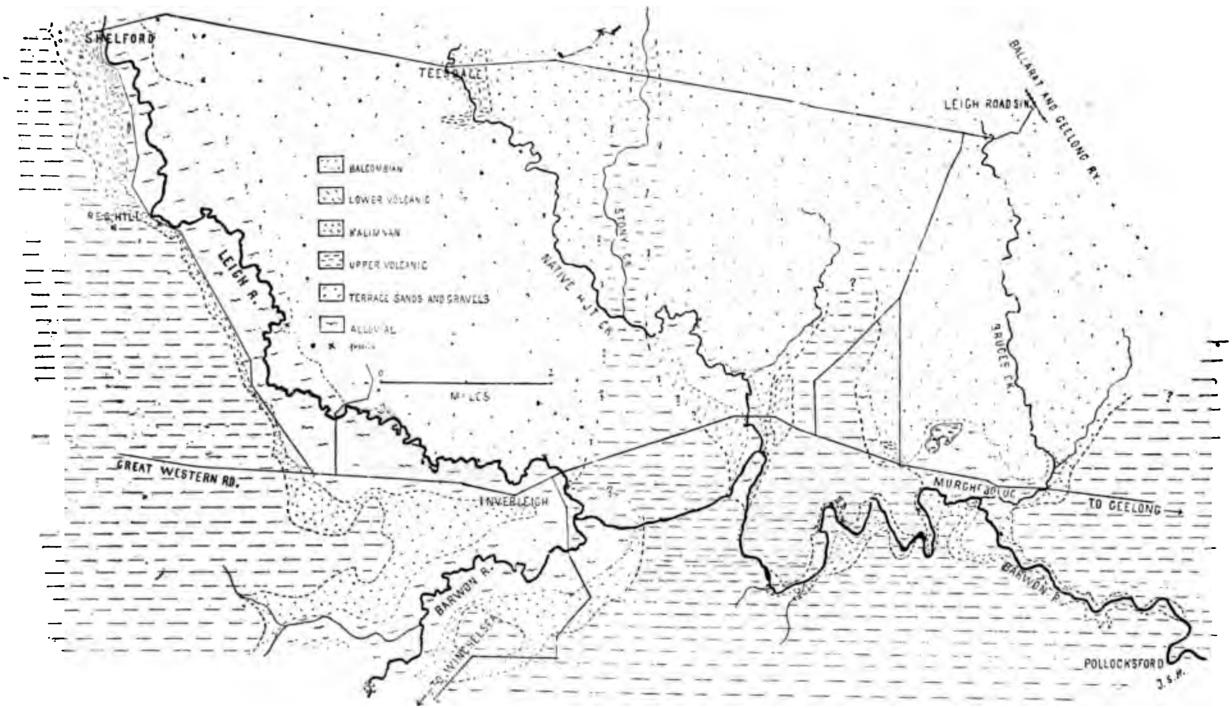
LIST OF FOSSILS (*continued*).

Name of Fossil.	Inverleigh.	Native Hut Creek.	Murgheboluc.	Barwon R. Bruce's Creek Junction.
	1	2	3	4
Cephalopoda.				
Nautilus, n. sp.- - - -	1	2	3	4
Brachiopoda.				
Magellania garibaldiana, Davidson -	1	2	3	4
„ corioensis, McCoy -	.	.	3	4
Terebratulina scoulari, Tate -	.	.	3	.
Terebratula tateana, Johnston -	.	2	3	4
Zoantharia				
Placotrochus deltoideus, Duncan -	1	2	3	4
„ elongatus, Duncan -	1	2	3	4
Flabellum victoriae, Duncan -	1	2	3	4
„ gambierense, Duncan -	1	2	3	4
Balanophyllia australiensis, Duncan	1	.	3	.
Bathyactis lens, Duncan - -	1	2	.	4
Ceratotrochus halli, Dennant -	1	.	.	.
Notophyllia gracilis, Dennant -	1	.	.	.
Conosmilia anomala, Duncan -	1	.	.	.
„ striata, Dennant - -	1	.	.	.
Pisces				
Carcharodon megalodon, Agassiz -	.	2	.	.
Cestracion, n. sp. - - -	.	.	.	4

SUMMARY.

Pisces - - - - - -	2	
Cephalopoda - - - - -	1	
Gastropoda - - · - -	124	
Lamellibranchiata - - -	53	
Brachiopoda - - - - -	4	
Zoantharia - - - . -	10	
	194	species.

Inverleigh - - - - - - -	125	species.
Native Hut Creek - - - -	127	„
Murgheboluc - - - - -	89	„
Barwon River, Bruce's Creek Junction -	122	„



Geological Map of the Inverleigh District.

LITERATURE.

1. *Pritchard (G. B.)*—Remarks on the Tertiaries of Australia, together with Catalogue of Fossils. Adelaide, Govt. Printer, 1892.
2. *Pritchard (G. B.)*—Contributions to the Palæontology of the Older Tertiary of Victoria. Proc. Roy. Soc. Vic., 1894 (1895), p. 228.
3. *Dennant (J.)* and *Mulder (J. F.)*—The Geology of the Lower Leigh Valley. Proc. Roy. Soc. Vic., vol. ix., 1898, p. 56.

ART. XVIII.—*On a Collection of Upper Palaeozoic and Mesozoic Fossils from West Australia and Queensland, in the National Museum, Melbourne.*

BY FREDERICK CHAPMAN, A.L.S., &c.,

National Museum.

(Plates XXVII.-XXX.).

[Read 8th December, 1903].

INTRODUCTORY REMARKS.

The fossils enumerated or described in this paper consist of a series of plant and various invertebrate remains, chiefly mollusca, sent in March, 1866, by the Hon. Sir (then Mr.) A. C. Gregory, K.C.M.G., F.R.G.S., to Mr. Richard Daintree, F.G.S. The latter forwarded them, with others of his own collecting, to Professor F. M'Coy, for the National Museum collection.

We are, in this paper, chiefly concerned with the specimens from the Gregory collection. These fossils were not localised, but bore numerals referring them to sets from various districts. Two of the localities from whence they came were mentioned in a letter accompanying the collection, from Mr. A. C. Gregory to Mr. Daintree, dated 6th March, 1866, and which runs as follows :—

"I send you a few of the fossils from the West Coast in forming a flat-topped range 600 to 800 feet high. Sandstone, latitude 28° 20′. The specimens are from the upper beds of rock, shale and limestone alternate and rest on gneiss-rock, which is rich in mineral veins, several being worked for copper and lead. Inland of this range is a valley 50 miles wide, occupied by Carboniferous rocks and beds of coal resting on limestone, which closely resemble the lower beds on the Hunter River ; these seem to rest on a thin bed of old slate without trace of fossils, and below it the granite, which forms the main table-land of West Australia."

The above notes in Sir A. C. Gregory's letter relate to the fossils from the districts of the Greenough and Irwin Rivers, of Mesozoic and Carbo-permian ages respectively. The fossils from the Greenough River were easily recognised. Any doubts about the localities of the Palaeozoic fossils have been cleared up within the last few months by the Hon. Sir A. C. Gregory, who very kindly favoured us with further notes on the fossil localities. Sir A. C. Gregory also stated that the West Australian fossils were not collected by himself personally, but were forwarded to him by residents in the districts where he had previously collected specimens.

Since the original specimens of West Australian Mesozoic fossils described by Charles Moore are, presumably, in the Bath Museum, and other records of West Australian fossils are not too numerous, it has been considered of sufficient interest and importance to publish some notes on the collection now before us.

The Palaeontological Literature of the West Coast District.

The ages of the fossiliferous beds of the Greenough River and Irwin River districts were stated to be Mesozoic and Carboniferous as early as 1861,[1] by Mr. F. T. Gregory, who, however, classed the Mesozoic fossils as doubtfully Cretaceous. A list of the fossils sent to London with Mr. Gregory's paper was inserted by the editor of the Quarterly Journal, Professor (then Mr.) T. Rupert Jones,[2] who also referred to these fossils as of secondary age.

Charles Moore gave, in 1862, an account of some fossils from West Australia, and referred them to the Mesozoic period.[3]

Later, the same author, in a paper read before the Geological Society of London,[4] describing a series of fossils collected by Messrs. Shenton and Clifton in Western Australia, referred the strata which yielded them to the Middle Lias or the Lower

1 Quart. Journ. Geol. Soc., vol. xvii. (1861), p. 480.
2 *Tom. cit.*, p. 484.
3 Rep. Brit. Assoc., 1862 (1863), Cambridge Meeting, p. 83.
4 Quart. Journ. Geol. Soc., vol. xxvi. (1870), p. 229.

Oolite of Europe. Moore also recognised typical Cretaceous fossils from this district.

The Government Geologist for Western Australia (H. Y. L. Brown), in 1873,[1] dealt in some detail with the stratigraphy of the Greenough River district, and regarded these beds as of Oolitic age. In the same report the chalky limestone of Gin Gin and Yatheroo, which overlies the ammonite-bearing beds, is referred to as most likely of Mesozoic age. A useful geological map of the West Coast district accompanies this report, and the horizontal sections give a good idea of the peculiar conformation of this part of the country, with its characteristic flat-topped ranges.

H. P. Woodward (Government Geologist, W.A.) gave, in his annual report for 1890-1891, a list of Mesozoic fossils; but these are all from the Victoria district.

G. C. Crick has done good service in re-examining Chas. Moore's original types of Jurassic Cephalopoda, as well as describing many specimens from other collections, and which are distributed among the Bath Museum, the Geological Society's Museum and the Natural History Museum, London. This work appeared in two papers, published in the "Geological Magazine," in 1894.[2]

The Carbo-permian fossils of the Irwin River district came from the area known as the "Coal-seam," which is about fifty miles from the coast, on parallel 29°. The discovery of these Carboniferous rocks was made as early as 1846 by the brothers A. C., F. T. and H. C. Gregory;[3] and the occurrence of associated coal beds with a six-foot seam was recorded by Lt. Helpman, R.N.[4]

Although not dealing with the fossils of the Irwin River district, Hudleston's notes on fossils from north of the Gascoyne River[5] supply further knowledge of Upper Palaeozoic forms, and

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1 General Report on a Geological Exploration of that portion of the Colony of Western Australia lying southward of the Murchison River, and westward of Esperance Bay. Parliamentary Papers, No. 1, 1873.

2 Geol. Mag., Dec. iv., vol. i., 1894, pp. 385-393; pp. 433-441, pls. xii., xiii.

3 See Journal of an Expedition undertaken by the Messrs. Gregory in the months of August and September, 1846. Journ. R. Geogr. Soc., 1848, p. 26.

4 *Tom. supra cit.*, p. 41.

5 Quart. Journ. Geol. Soc., vol. xxxix. (1883), p. 582.

this author concludes, from the evidence before him, that the Upper Palaeozoic strata in this part of Australia correspond with the Lower rather than the Upper Carboniferous of other areas of Australia.

R. Etheridge, Jun.,[1] recorded several species of brachiopods and bivalves from the Irwin River Coal Field, as well as a Mesozoic Cucullaea from the Greenough River District (Paxton Coll.).

Messrs. E. T. Hardman and H. P. Woodward have extensively collected in the Upper Palaeozoic and Mesozoic beds of West Australia, and series of their fossils have been described by various specialists in England.

The widely distributed and variable fossil Ctenostreon pectiniformis has lately been figured by R. Etheridge, Jun., for the first time from Australia.[2]

Fossils from the Carboniferous[3] (Star Beds) of the Drummond Range, Queensland.

Collected and Presented by the Late Mr. Richard Daintree, F.G.S.

Plantae—Lycopodiales.

Lepidodendron australe, M'Coy. (Plate XXVII., Figs. 1–5).

Lepidodendron (Bergeria), australe, M'Coy, 1874. Prodr. Pal. Vict., Decade i., p. 37, pl. ix.

[For a full discussion of the specific standing of L. australe, see R. Etheridge, Jun., in Records Geol. Surv., N.S.W., vol. ii., pt. iii., 1891, p. 119].

Structure in L. australe.—Although much has been written on the subject of the Australian Lepidodendra, there is ample room for fresh discoveries, especially in relation to their structure and

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1 Ann. Rep. Dept. Mines, New South Wales, for 1889 (1890), p. 239.

2 Rec. Austr. Mus., vol. iv., No. 1, 1901, p. 13, pl. iii.

3 The "Star-beds" are here regarded as Carboniferous in correlation with beds in Victoria, similarly containing L. australe.

organization; for, as usually found, they consist only of more or less decorticated stems and branches, associated with fragments of leaves. The stem-remains generally present a striking appearance as fossil specimens, with their ornament of regular rhomboidal depressions; but the conditions of their preservation did not, in the majority of cases, favour the retention of their internal structure. It is, therefore, worthy of notice that some of the stems, branches, and even leaves of Lepidodendron from the Drummond Range show very clearly, under a moderate magnification, the fundamental tissue of the cortex underlying the epidermis, as a cellular meshwork. This structure seems to be invariably preserved in our specimens as a replacement by limonite, the latter being most probably derived from the actual rock in which the fossils are embedded, and which seems to have been originally a ferruginous and silty clay.

A specimen showing the parenchymatous tissue overlying the traces of the ridges bordering the rhombic leaf cushions of the stem is here figured (Pl. XXVII., Fig. 4).

The same specimen shows what may eventually prove to be the ligule; and in comparing this structure with other known examples it will be seen that it is here also seated in a pit or depression. Further, it occupies a similar relative position to the vascular impression; and in L. Australe both are nearer than is usual in other species to the upper angle of the rhombic area.[1]

Another example of the occurrence of the fundamental tissue preserved in L. australe is now also figured (Pl. XXVII., Fig 5). It is presumably near the extremity of a slender terminal branchlet. This particular specimen is of much interest, on account of its showing so well the parenchyma strengthened by traversing plates of sclerenchyma.[2]

Evidences of leaves.—The remains of leaf-fragments are abundant in the shales containing stems of Lepidodendron, but have been much mutilated prior to their enclosure in the original mud which formed the shale.

We now figure two of the more interesting specimens, one representing the back of a long parallel-sided leaf, having a

1 Compare Scott, Studies in Fossil Botany, 1900, p. 144, fig. 57B.

2 See Solms-Laubach, Fossil Botany, 1891, p. 217, fig. 22A (after Renault).

strong median ridge corresponding to the grooving of the opposite surface (Pl. XXVII., Fig. 2).

Another specimen noticed in the shale seems to be a small sporophyll, such as might be found closely grouped around the axis of the strobilus (Pl. I., Fig. 3). It shows the characteristic hollow for the reception of the sporangium.

Remarks on variation in the form of the leaf-cushions in Lepidodendron australe.—There are two specimens of L. australe in the present collection, occurring in a grey-coloured and limonitic shale, both of which show the transversely elongate form of the leaf-cushions[1]; a modification undoubtedly due to the fact that they represent older portions of the stem. On this point Kidston may be quoted[2]:—"In most species the increase in the girth of the stem has a tendency to produce a greater lateral increase in the proportion of the leaf-scars than is equalised by the upward growth of the trunk; consequently in some species, where the leaf-scars on the young twigs have a vertical length much greater than their width, their older conditions show proportionally a much greater transverse diameter."

The average relative diagonals of the rhombic leaf-cushions in the present specimens are:—Transverse, 13.5 mm.; vertical, 10.5 mm. An extreme form in another exposed fragment on one of these blocks measures 16 x 9 mm. That the variation of the relative elongation of the rhombic areas is due to the age of the stem is proved in the case of this Australian species by measurements which I have taken on the relative diagonals of the leaf-cushions of the type-specimen of L. australe, in the National Museum, a portion only of which was figured in the Prodromus by McCoy. Near the base of this type-specimen the leaf-cushions measure 10.5 mm. trans., by 8 mm. vert. Close to the top of the left branch they become almost equilateral, measuring 8 mm. trans., by 7.5 vert. The two points at which measurements were taken are 21 centimetres distant from one another.

The conspicuous depression usually seen near the upper angle of the leaf-cushion in L. australe must be regarded as the opening

1 "Leaf-scars" of some authors; a term applied more correctly to the upper portion of the area covered by the leaf base.

2 Cat. Palaeozoic Plants in the British Museum, Lond., 1886, p. 152.

through which the vascular bundle passed, connecting the leaf with the stem (the leaf-bundle having been torn away); for the actual leaf-base, which is closely connected with the stem, does not appear to have been preserved in the Australian specimens, since the lateral points of the parichnos[1] have not yet been detected. This latter structure it would be hopeless to look for, if we assume that the known specimens represent a "Bergeria" condition of the stem, in which the epidermis has been lost before fossilisation.

The elongate-elliptical depression indicating the passage of the vascular bundle is, as a rule, situated close to the upper angle of the rhombic area. On examining the type-specimen, I noticed that where these pits are central, or nearly so, they seem to be only partially preserved; that is to say, the lower portion of the vascular depression has been filled up and preserved as a cast, which, by its obliquity and projection, brings it nearer the centre. It would be interesting to discover whether this evidence is borne out in other examples that may come under observation.

On the same pieces of shale there are several fragments of what at first sight appear to be remains of Cordaites, but, although this genus has been recorded from the Drummond Range, in this instance, it seems safer to regard these fragments as decorticated branches of Lepidodendron, chiefly on account of the parallel grooving of the fragments bearing indication of intermittent thickening along the slender ridges.

Fig. 1, on Plate XXVII., is taken from a specimen from Wynn Creek, Queensland, presented to the National Museum by R. Daintree, Esq.; it was selected for figuring on account of the greater detail on its surface.

L. australe has previously been noted from the Drummond Range by Tenison Woods.[2]

Locality and Horizon.—Drummond Range, near Clermont, Queensland. Star beds. [2161-2; 1376-7].

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1 See Scott, Studies in Fossil Botany, p. 120, fig. 50.

2 Journ. R. Soc., N.S.W., 1882 (1883), vol. xvi., p. 179; Proc. Linn. Soc., N.S.W., 1883 (1884), vol. viii., pt. 1, p. 135.

FOSSILS FROM THE CARBO-PERMIAN[1] OF QUEENSLAND AND WESTERN AUSTRALIA.

COLLECTED BY MESSRS. A. C. GREGORY AND R. DAINTREE.

PLANTAE—EQUISETALES.

Phyllotheca australis, Brongn. (Pl. XXVII., Figs. 6–7).

Phyllotheca australis, Brongniart, 1828. Hist. Foss. Végét., p. 152.

Feistmantel, 1878. Palaeontographica, Suppl. Band. III., Lief. III., Heft. 3, p. 83, pl. vi., fig. 3; pl. vii., figs. 1–2; pl. xv., fig. 1. *Idem*, 1890. Mem. Geol. Surv., N.S.W., Pal. No. 3, p. 79, pl. xiv., figs. 1–4 (fig. 5 = P. deliquescens, Goepp; see Arber, *loc. infra cit.*, p. 17, synonomy).

Etheridge, Jun., 1892 (in Etheridge and Jack). Geol. and Pal. of Queensland, p. 189, pl. xvii., fig. 3.

Arber, 1902. Quart. Journ. Geol. Soc., vol. lviii., p. 14.

This species has already been recorded from the Bowen River Coal Field in Queensland, although not from the precise locality as the present example, and it is possible that our specimen comes from the same horizon in the series.

A slab of black, carbonaceous shale in the present collection is crowded with remains of the stems of Phyllotheca and Archaeocalamites. At first sight it seemed possible that these stems were all referable to the genus Phyllotheca, the broader and more closely-grooved forms closely resembling Phyllotheca deliquescens (Goeppert). The presence of leaf-scars was afterwards detected, on a closer examination, which compels one to refer these particular stems to the Calamites section of the Equisetales.

The stems of Phyllotheca now under consideration are slender and generally coarsely fluted or grooved, having usually only 4 to 5 vertical furrows visible. The width of the stems varies from 5 to 10 mm. The leaf-sheaths are well preserved in some

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1 The later (coal-bearing) Carboniferous strata of Australia and Tasmania are usually referred to as Permo-carboniferous. There is, however, good reason for reversing the components of this term to ensure uniformity with words like Siluro-devonian or Trias-jura, which refer in their proper age sequence to strata having a mixed fauna. "Hunterian," as suggested by Professor Ralph Tate, is possibly a convenient term to apply to these beds, which, as the Hunter River Series, are so well developed locally.

cases, and the internodes vary in vertical height from 10 to 15 mm. The separate leaf-like terminations of the sheaf have a distinct mid-rib, characteristic of this genus.

Fructification in Phyllotheca.—Arising from the base of what appears to be an undoubted leaf-sheath of Phyllotheca australis, which has been torn from the stem, is an extremely interesting example of a stout, sub-rotund strobilus, covered with numerous ovate imbrications (Pl. XXVII., Fig. 7). The distal end of this specimen was presumably flat, and the strobilus seems to have been sheathed around the external margin with small bracts or sporophylls. A somewhat similarly formed cone has been described by Kidston,[1] under the name of Equisetites hemingwayi.

Another remarkable specimen occurs along with the Phyllotheca stems. It is conoidal and imbricated and strongly resembles the conical group of sporophylls seen in some species of Equisetum. Similar strobili have been described and figured by R. Etheridge, Jun.,[2] found as terminal cones attached to actual stems of Phyllotheca. Our specimen is cylindrically ovate and terminates in a somewhat sharp apex. Its length, so far as preserved, is 18 mm. One side of the strobilus has been ruptured, and the surface spread out lengthwise. The imbricated scales are set closely to one another, and terminate in blunt points. They alternate, as in Etheridge's specimens, with the series above and below. Where the surface has been flattened out, however, there is evidence of long filamentous leaves, similar to those seen in the strobili described by Etheridge, Jun.

The recorded examples of fructification in Phyllotheca are few, and until the discovery of the strobili by Messrs. J. Mitchell and C. Hedley in the Upper Coal Measures of Newcastle, New South Wales, and which Mr. Etheridge has described and figured, there was only one instance in which a supposed inflorescence had been seen in Phyllotheca australis, which was described many years ago by M'Coy[3]. That author figured a portion of a fertile branch with closely set joints, having sheaths which bore on their upper margin a fringe of "anthers," which he compared

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1 Ann. Mag. Nat. Hist., ser. 6, vol. ix., 1892, p. 138. See also Seward's "Fossil Plants," Cambridge, 1898, p. 262, fig. 57A.

2 Rec. Austr. Mus., vol. iv., No. 1, 1901, pp. 1-4, pls. i., ii.

3 Ann. Mag. Nat. Hist., vol. xx., 1847, p. 155, pl. xi., fig. 1.

with the male flowers of Casuarina stricta. Arber has re-examined this specimen[1], which is in the Woodwardian Museum at Cambridge, but he failed to find any leaf-sheath, and only one leaf-like segment, and suggested that the striated internodes have been mistaken for leaf-sheaths. Remarking on this specimen, Arber says :—"The preservation of the fossil is by no means good, and will only permit me to say that at each node, and on either side, a bunch occurs of several small ovate bodies, apparently closely attached to the node, which may be sporangia. I have not, however, been able to make out any sporangiophores, or further details." The fructification of the Permian examples of Phyllotheca described by Schmalhausen[2] consists of sporangia, borne on peltate sporangiophores attached to the internodal area of the stems between the infertile leaf-whorls. Zeiller has described the fructification of Phyllotheca rallii,[3] in which the sporangiophores alternate with the whorls of sterile bracts.

That our second described specimen is comparable with the beautiful examples from the New South Wales coal-measures does not admit of doubt, on referring to the illustrations given by Etheridge, Jun. As regards the laterally formed strobilus now figured, attached to the leaf-sheath, it is open to question whether this represents another mode of fructification for the same species, but more light may be looked for on this interesting point by the discovery of further specimens. In Equisetites hemingwayi, mentioned above, the cones are sessile, as in our example, but no leaves occur on the nodes with the cones.

Locality and Horizon.—From the Baron River (a southern tributary of the Burdekin River) below the coal seams, Queensland. Carbo-permian. [1381 ; 2167.].

Archaeocalamites scrobiculatus, Schlotheim sp. (Pl. XXVII., Figs. 8, 9).

Calamites scrobiculatus, Schlotheim, 1820. Petrefactenkunde, Abth. 1, p. 402, pl. xx., fig. 11.

C. radiatus, Brongniart, 1828. Hist. Foss. Végét., p. 122, pl. xxvi., fig. 2.

1 Quart. Journ. Geol. Soc., vol. lviii., 1902, p. 16.

2 Mém. Acad. Imp. Sci., St. Petersburg, ser. 7, vol. xxvii., No. 4., 1879.

3 Mém. Soc. Geol. France, Pal. Mém., No. 21, vol. viii., fasc. iv., 1899, p. 65.

Asterocalamites scrobiculatus (Schloth.), Eth., Jun. (in Eth. and Jack). Geol. and Pal. Queensland, 1892, p. 189, pl. iv., figs. 11 and 12.

Archaeocalamites scrobiculatus (Schloth.), Seward. Fossil Botany, 1898, p. 386, fig. 103.

Stems of the above plant are associated with Phyllotheca in the specimen now being described, one example measuring 22 cm. in length. Greatest width 24 mm. The surface of the stem is closely striate, the groovings numbering about 24 on the larger portion of one stem. There are a few scattered and attached filiform leaves associated with the stems, and others can be indistinctly seen closely adpressed near the nodes. Leaf and branch scars are not infrequent, and appear as circular depressions with a central mammilla, sometimes radially striate (Pl. XXVII., Fig. 9). The stem grooves pass continuously from internode to internode.

This plant occurs here at a higher horizon than was formerly known, for its previous records are restricted to the Star beds.

It is just possible that some of the doubtful forms thought to be Phyllotheca of the P. deliquescens type may eventually prove to be referable to Archaeocalamites.[1]

Locality and Horizon.—From the Baron River (a southern tributary of the Burdekin River), below the coal seams, Queensland. Carbo-permian. [1381.].

FILICALES.

Glossopteris browniana, Brongniart.

Glossopteris browniana, Brongn., 1828. Hist. Foss. Véget., p. 223, pl. lxii.

Feistmantel, 1878. Palaeontographica, Suppl. Band iii., Lief. iii., Heft 2, p. 78; Heft 3, p. 90; pl. viii., figs. 3–4; pl. xix., figs. 1, 1*a*, 3, 4, 4*a*, 5, 5*a*, 7; pl. xi., fig. 1.

Idem, 1890. Mem. Geol. Surv., N.S.W., Pal. No. 3, p. 121; pl. xiii., fig. 1; pl. xvi., fig. 34; pl. xvii., figs. 1, 3, 4, 5 (?), 7; pl. xx., fig. 2.

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1 *Cf.* Seward, Quart. Journ. Geol. Soc., vol. liii. (1897), p. 324, pl. xxiv., fig. 1; also "Fossil Plants," Cambridge, 1898, p. 285, fig. 67; also Feistmantel, 1890, Mem. Geol. Surv., N.S.W., Pal. No. 3, p. 79, pl. xiv., fig. 5.

Etheridge, Jun. (in Etheridge and Jack), 1892. Geol. and Pal., Queensland, p. 193, pl. xvi., figs. 6, 8 ; pl. xvii., figs. 9–10.

Some pieces of greenish coloured sandstone from the Baron River show several recognisable leaves of this species. Their nervation is beautifully contrasted in white on the dark green sandstone surface. It is of interest to note the occurrence of what appears to be an imbricated stem, resembling a terminal spike of Lepidodendron, on one of the slabs with the Glossopteris; but it is not sufficiently well preserved to enable one to determine its relationship with certainty.

Locality and Horizon.—Baron River (below coal seams), Queensland. Carbo-permian (Bowen River Coal Fields). [1378; 1619.].

Glossopteris ampla, Dana.

Glossopteris ampla, Dana, 1849. Geol., Wilke's U.S. Expl. Exped., p. 717 ; Atlas, pl. xiii., fig. 1.

Feistmantel, 1878. Palaeontographica, Suppl. Band iii., Lief iii. Heft 3, p. 91, pl. xi., fig. 2 ; pl. xii., fig. 7.

Etheridge, Jun. (in Etheridge and Jack), 1892. Geol. and Pal., Queensland, p. 195, pl. xv., fig. 7.

In the present collection there are two pieces of sandstone bearing impressions of the leaves of the above species. This form has previously been recorded from the Bowen River Coal Field, at Coral Creek, by Etheridge and Jack.

Locality and Horizon.—Baron River (below coal seams), Queensland. Carbo-permian (Bowen River Coal Fields). [1379-80.].

Glossopteris parallela, Feistmantel.

Glossopteris parallela, Feistmantel, 1878. Palaeontographica, Suppl. Band iii., Lief. iii., Heft 3, p. 93, pl. ix., figs. 2–4.

A specimen of sandstone from the Queensland collection bears portions of seven leaves on its surface, three of which are sufficiently complete to show their characteristic elongate form. The nervation of the leaves is clearly marked, and compares closely with the examples of G. parallela, figured and described by Feistmantel. The parallel character of the nervation is seen at a glance, and is due to the elongation of the polygonal areas

formed by the anastomosing nerves. The mid-rib is broad and distinctly hollowed.

It is interesting to note the occurrence of this species in the Bowen River Coal Field of Queensland, since its previous records seem to have been only from the upper coal measures of Bowenfels in New South Wales.

Locality and Horizon.—Baron River (below coal seams), Queensland. Carbo-permian (Bowen River Coal Fields). [2160].

CONIFERAE.

Araucarioxylon, Kraus, 1864.[1]

General Remarks on the Determination of Fossil Coniferous Wood.—The generic name Araucarioxylon is here employed in a restricted sense for coniferous wood allied to Araucaria and Dammara, and agrees in the main with Kraus' definition, in having the medullary rays in a single row on the tangential section, with bordered pits mutually in contact.[2] The determination of generic or typical groups in the Coniferae from a microscopical examination of their fossil woods is a somewhat hopeless task, notwithstanding the beautiful preservation of the tissues in many silicified and otherwise mineralized specimens. Although the wood thus mineralized often shows a structure so well replaced that thin sections of it can be examined in all their details, under a high magnification, with that of a recent wood; yet, as some eminent palaeobotanists, as Solms-Laubach,[3] Scott,[4] and others, have recently pointed out, unless we can examine sections taken from all parts of the stem and root, and sliced in the various directions necessary to give a complete knowledge of their structure, we may easily fall into the error of confusing the woods of entirely different groups. The above genus affords a case in point, in which the stems of Cordaites were grouped

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1 G. Kraus.—"Mikroskopische Untersuchungen über den Bau lebender und vorweltlicher Nadelhölzer." Würzburger Naturwiss. Zeitschr, vol. 5 (1864).

See also Schimper, 1870, Traite, Pal. Vég., vol ii., pt. 1, p. 380.

2 The arrangements and characters of the bordered pits of the tracheides are, however, so inconstant, even in the Araucarian group, that little value can be attached to them for determinative purposes.

3 "Fossil Botany," Cambridge, 1891, pp. 80-82.

4 "Studies in Fossil Botany," London, 1900, p. 419.

with true coniferous wood. The Cordaitean stem, for example, exhibits in its secondary wood tracheides with bordered pits, a character for long supposed to be typical of Coniferous woods, and, in fact, very closely resembling, if not identical with, that of Araucaria itself. Undoubted stems of Cordaites have also yielded in the earlier portion of the xylem the scalariform and spiral elements commonly seen in many other plants.

In the present instance the wood structure has been carefully compared with sections of wood taken in various directions from Araucaria cunninghami and Dammara australis. For the opportunity of examining these recent woods I am indebted to Mr. R. H. Walcott, of the National Museum.

Occurrence of Palaeozoic Fossil Wood in Australia.—Silicified stems and roots of trees have long been known to occur in the upper palaeozoic strata of Queensland[1] and New South Wales.[2]

With regard to the Queensland occurrences Jack remarks on the silicified wood exposed on the sides of Jack's Creek, as follows[3]:—"About a mile north of the Bowen River a thickness of about fifty feet of greenish-gray sandstone is seen, containing numerous, large, drifted coniferous trees. The trees, which are silicified to a black flint, and sometimes opalized, occasionally retain some of the branching roots. Fragmentary plant remains, in a carbonized condition, are also common. About half a mile from the river the creek divides into two branches, both of which show for some distance up sections of the greenish-gray pebbly sandstone with silicified drifted trees. One tree measured thirty-one feet in length and tapered from twelve inches to three inches in diameter."

The same author mentions other large silicified trees, about a quarter of a mile west of Rosella Creek, in one of which he counted about thirty rings of growth.

Of the Upper Bowen formation of Walker's Creek, Jack remarks[4]:—"Some sandstone beds in the neighbourhood contain silicified logs, and similar logs, evidently weathered out of the

1 Etheridge, Jun., and Jack. Geol. and Pal., Queensland, 1892, pp. 165, 166, 168, 175.

2 Nicol, Edinburgh New Phil. Journ., vol. iv., 1832, p. 153; Clarke, Quart. Journ. Geol. Soc., vol. iv., 1848, p. 60; Dana, Geol. U.S. Expl. Exped., 1849, p. 714; Eth. Jun., Cat. Aust. Foss., 1878, p. 32 (footnote *e*).

3 *Tom. cit.*, p. 165.

4 *Tom. cit.*, p. 168.

sandstone, bestrew the surface in the neighbourhood so thickly that one might imagine a forest to have been felled on the spot and subsequently petrified."

It is interesting to notice that these coniferous tree-remains are not confined to the freshwater (upper) series of the Bowen River Coal Field, but that they are also found in the marine (middle) series.

Araucarioxylon daintreei, sp. nov. (Plate XXVIII., Figs. 1–3; Plate XXIX., Figs. 1–3; Plate XXX., Figs. 3–4).

Chief Characters.—Stem sub-elliptical in section in the present example. The broken, transverse surface shows very clearly the succession of rings of the wood cells (annual rings). Area of pith cells very restricted, the bundle measuring in this specimen 1.7 mm. in diameter. The pith bundle is not circular in transverse section but somewhat elongated in one direction, and angular on the periphery. The parenchymatous cells of which it is composed are rectangular to polygonal in transverse section. They are made out with difficulty in this direction on account of their absorption of so much iron oxide along with their silicification. The primary xylem appears to consist of four or five rows of tracheides, which show traces of scalariform and spiral structure in the sections taken through the stem in a radial direction.

The tracheides of the secondary wood are sub-rectangular in transverse section, and run in series of 4 to 6 between the medullary rays in plane section. No resin cells were noticed.

The radial section shows the pith cylinder to be immediately followed by the short series of scalariform and spiral elements mentioned above, and succeeded by the secondary xylem. The ordinary prosenchymatous vessels forming the wood have their radial surfaces crowded with bordered pits, showing the central mark as an oblique, elliptical, slit-like depression, and similar to those in both the Araucariae and the Cordaiteae. The pits are closely adpressed, but generally not so close as to become polygonal; they occur sometimes in single rows, but more often in as many as 4 to 6.

In tangential section the medullary rays are in single rows. They are of a simple type and therefore do not carry horizontal resin canals, as in the fossil wood referred by Kraus[1] to the type Pityoxylon.

The present specimen measures in its longest diameter about 9 cm.

General Remarks on the Specimen and its Alliances.—The stem now under description is clearly distinguishable from the wood of Cordaites, on account of the definite annual rings seen throughout the stem. Although these rings are somewhat irregular in the earlier part of the wood, and show a tendency to thin out at various places, causing an appearance of overlapping, they are very distinct later on, and throughout each complete ring show the regular transition from the spring to the autumn growth, and the sudden recurrence to the former with less crowded cell-structure. This feature of differentiated wood cells seems to be unknown in Cordaites, where the xylem is practically uniform in structure.[2]

The most important factor, however, in determining the difference between the Coniferous wood and Cordaites is the nature of the pith cylinder, which in the latter is unusually thick and transversely ruptured, so as to leave numerous diaphragms separated by cavities.

The pith is very small in our specimen, and the primary xylem is also of very limited extent.

With regard to the bordered pits seen in the radial walls of the tracheides, I notice that in our specimen of Araucarioxylon they agree most closely with those seen in Dammara australis, in that they are less crowded and only occasionally polygonal. The bordered pits in the tracheides of the wood of Araucaria cunninghami are perhaps more comparable with those seen in Cordaites, although much larger. The central depression is elliptical and oblique in all four types, so that this particular feature cannot be relied on as a determinative character.

There is, therefore, in view of the foregoing statements, no doubt as to the Coniferous affinities of our specimen.

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1 *Tom. supra cit.* See also Traité de Paléontologie., pt. ii., 1891, Palaeophytologie, by Schimper and Schenk, p. 856, fig. 417.

2 Scott—Studies in Fossil Botany, p. 419.

Another reason for referring the present specimen to the genus or type of Araucarioxylon is the absence of resin cells in the medullary rays and among the vertical tracheides.

It differs from the Cedroxylon type of coniferous wood—to which it otherwise bears most resemblance—not only in the above feature, but also in having the medullary rays, as seen in transverse section, more widely separated, and also in having the bordered pits of the radial walls of the tracheides disposed in several rows, instead of singly, as seems to be the general, though not invariable, rule in Cedroxylon

Enough has probably been said, having regard to the limited material at present at our disposal, upon the claims of the above to be regarded as a typical Araucarioxylon. This has been already done by Carruthers[1] and Etheridge, Jun.,[2] for the fossil wood found in the Bowen River formation; but these authors have unfortunately given no figures or description of any definite specimen, so that the name by which the fossil wood from Queensland was previously recorded must now lapse, as Mr. Etheridge himself suggests when recording the fossil wood occurrences.[3] The diagnosis now given will, it is hoped, strengthen the claim of the Conifers to be considered as having existed indubitably in Carboniferous times.

Locality and Horizon.—Baron River (a southern tributary of the Burdekin River), below the coal seams, Queensland. Carbo-permian (Bowen River Coal Fields). Coll., Hon. Sir A. C. Gregory and R. Daintree, Esq. [2235.].

Animalia–Coelenterata.

Stenopora leichardti, Nich. and Eth., Fil.

Stenopora leichardti, Nicholson and Etheridge, Jun., 1886. Ann. Mag. Nat. Hist., vol. xvii., p. 179, pl. iii., figs. 7–8. Etheridge, Jun., 1892 (in Etheridge and Jack). Geol. and Pal., Queensland, p. 204; pl. vi., figs. 9–10; pl. vii., fig. 2.

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1 *Araucaroxylon nicholi*, Carruthers, in Etheridge, Jun. Proc. R. Phys. Soc., Edinb., 1880, vol. v., p. 328.

2 *Araucaroxylon nicholi*, Carruthers (M.S.), Eth., Jun. (in Eth. and Jack). Geol. and Pal., Queensland, 1892, p. 198.

3 *Loc. supra cit.*

Our specimens from the Irwin River district are entirely replaced by limonite, but so perfectly that the exact form of the corallites can be seen under a slight magnification, as well as the large acanthopores, supposed to be a distinguishing feature of this species. Other points worthy of notice are the cylindrical and branching habit of the corallum, and the periodical external thickening of the corallites.

Locality and Horizon. — Irwin River District, Western Australia. Carbo-permian. [1397; 2159.].

Crinoidea.

Several pieces of crinoid stems occur in a brown sandy matrix. The columnals are circular in section, with radially striate surfaces, and having a small circular axial canal. They appear to belong to the family of the Actinocrinidae, but cannot be determined with certainty, as no remains of the calyx or arms were met with. Crinoid stems have been recorded from the Gascoyne River, Western Australia, by A. H. Foord,[1] who states that F. A. Bather regards them as probably referable either to the Rhodocrinidae or Actinocrinidae.

Locality and Horizon.—Irwin River district, Western Australia. Carbo-permian. [2110.]

Brachiopoda.

Derbyia (*cf.*) **senilis**, Phillips, sp.

Spirifer senilis, Phillips, 1836. Illustr. Geol. Yorkshire, vol. ii., p. 216, pl. ix., fig. 5.

Derbyia senilis (Phill.), Etheridge Jnr., 1892 (in Eth. and Jack). Geol. and Pal. Queensland, p. 246, pl. xii., figs. 1-6.

The only specimen in our collection from Daintree is a cast in limonite of the interior of a portion of the dorsal and ventral valves. The surface of the cast clearly shows the punctation of the shell, as innumerable tiny tubercles.

Locality and Horizon.—Irwin River District, Western Australia. Carbo-permian. [2111.].

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1 Geol. Mag., vol. vii. (1890), p. 104.

Strophalosia clarkei, Etheridge, sp.

Productus clarkei, Etheridge, 1872. Quart. Journ. Geol. Soc., vol. xxviii., p. 334, pl xvii., figs, 2, 2*a*, *b*; pl. xviii., figs. 4, 4*a*.

Strophalosia clarkei (Eth.), Etheridge Jun., 1892. (In Eth. and Jack). Geol. and Pal., Queensland, p. 258, pl. xiii., figs. 12-17; pl. xiv., fig. 19.

A dorsal and a ventral valve occur separately in the present collection. Foord[1] records this shell from the Kimberley District, Western Australia.

Locality and Horizon.—Irwin River District, Western Australia. Carbo-permian. [2163-4.].

Productus undatus, Defrance.

Productus undatus, Defrance, 1826. Dict. Sci. Nat., vol. xliii., p. 354.

Foord, 1890. Geol. Mag., vol. vii., p. 152, pl. vii., fig. 6.

This species has already been recorded from the Irwin River District by Foord. We have two specimens which, although internal moulds of the shell, show the bases of the spines, and the undulating wrinkles of the shell itself.

Locality and Horizon.—Irwin River District, Western Australia. Carbo-permian. [1385-6].

Productus cora, d'Orbigny.

Productus cora, d'Orbigny, 1842. Voy. Amérique mérid., vol. iii., pts. 3 and 4, p. 55, pl. v., figs. 8–9.

P. cora, d'Orb., Etheridge, Jun., 1892 (in Eth. and Jack). Geol. and Pal., Queensland, p. 248; pl. xii., fig. 14; pl. xiii., fig. 1; pl. xxxviii., fig. 11.

The examples in the present series are chiefly contained in a large block of limonitic sandstone. One of the valves measures 5 cm. in width, and a little over 4 cm. in length; whilst another imperfect specimen must have measured when complete between 6 and 7 cm. in width.

These specimens are denuded of spines, but traces of them are seen in the surrounding matrix. Some of the valves show the

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1 Geol. Mag., vol. vii., 1890, p. 103.

wrinklings at the cardinal angles, and faint concentric folds on the surface of the shell.

Locality and Horizon.—(?) Bowen River Coal Field, Queensland. Carbo-permian. Coll. and presented by R. Daintree, Esq. [2112-3].

Spirifer convolutus, Phillip, sp.

Spirifera convoluta, Phillips, 1836. Illustr. Geol., Yorkshire, vol. ii., p. 217, pl. ix., fig. 7.

This species has been previously recorded from beds of similar age on the Gascoyne River.

A specimen of this shell in a brown sandstone matrix occurs in the present collection.

Locality and Horizon.—(?) Bowen River Coal Field, Queensland. Carbo-permian. Coll. and presented by R. Daintree, Esq. [2166].

Spirifer (Martiniopsis) subradiatus, Sow.

Spirifera subradiata, Sowerby, 1844, in Darwin's Geol. Observations Volc. Ids., p. 159.

One specimen of the above, of a transversely oval form, occurs in our series, presented and collected by Daintree.

Locality and Horizon.—(?) Bowen River Coal-field, Queensland. Carbo-permian. [2114].

PELECYPODA.

Sanguinolites (*cf.*) hibernicus, Hind.

Sanguinolites hibernicus, Wheelton Hind, 1900. Pal. Soc. Mon. —Brit. Carb. Lamell., pt. v., p. 375, pl. xli. figs. 1-4.

A cast of an ovate elongate shell with prominent umbones occurs in this series, and seems closely allied to the above species. The concentric sulcate ornament on the shell-surface is fairly regular. The cast is haematitic in composition.

Locality and Horizon. — Irwin River District, Western Australia. Carbo-Permian. [2118].

Allorisma (*cf.*) maxima, Portlock, sp.

Sanguinolaria maxima, Portlock, 1843. Rep. Geol. Londonderry, p. 434, pl. xxxvi., figs. 1*a*, *b*.

Allorisma maxima (Portlock), Hind, 1890. Pal. Soc. Mon.—Brit. Carb. Lamell., pt. v., p. 419, pl. xlvii., figs. 5-7*a*.

Our specimen is a cast of a left valve and part of the right, preserved in a limonitic sandy matrix. The surface of the cast next the shell is smooth and shows the sulcate ornament very clearly. The valve is somewhat straight on the ventral edge, gibbous in front of the beaks, and compressed behind. It compares very closely with the above species.

Locality and Horizon.—Irwin River District, Western Australia. Carbo-permian. [2165].

Allorisma curvatum, Morris.

Allorisma curvatum, Morris, 1845 (in Strzelecki's Phys. Descr. N.S.W. and Van Dieman's Land), p. 170, pl. x., fig. 1.

A large specimen, which must have measured 16 cm. in length when complete, occurs in the present series. It is an internal cast of the two valves, which had been slightly displaced before the infilling of the interior.

Locality and Horizon.—Irwin River District, Western Australia. Carbo-permian. [1387].

Cephalopoda.

Goniatites micromphalus, Morris, sp.

Bellerophon micromphalus, Morris (in Strzelecki's Phys. Descr. N.S.W., p. 288, pl. xviii., fig. 7).

Goniatites micromphalus (Morris), de Koninck, 1877. Recherches sur les Fossiles Paléozoiques de la Nouvelles-Galles du Sud (Australie), p. 339, pl. xxiv., fig. 5.

Foord, 1890. Geol. Mag., vol. vii., p. 104, pl. v., figs. 10–10*a*.

Etheridge, Jun., 1892 (in Etheridge and Jack). Geol. and Pal., Queensland, p. 294.

Goniatites (Prolecanites ?) micromphalus (Morris), Etheridge, Jun., 1894. Rec. Geol. Surv. N.S.W., vol. iv., pt. 1, p. 36, pl. vii., figs. 9–14.

This form has already been recorded from Western Australia, from Liverynga, Kimberley District, by Foord.[1]

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1 *Loc. supra cit.*, p. 104.

A neat cast in limonitic limestone occurs in the present series.

Locality and Horizon.—Irwin River District, Western Australia. Carbo-permian. [1383.].

FOSSILS FROM THE JURASSIC OF THE GREENOUGH RIVER DISTRICT, WESTERN AUSTRALIA.

COLLECTED FOR THE HON. SIR A. C. GREGORY, AND PRESENTED BY THE LATE R. DAINTREE, ESQ.[1]

MOLLUSCA–PELECYPODA.

Cucullaea, Lamarck.

Cucullaea semistriata, Moore.

Cucullaea semistriata, Moore, 1870. Quart. Journ. Geol. Soc., vol. xxvi., p. 250, pl. xiv., fig. 3.

This species was originally recorded by Moore from the Greenough River district, and it appears to be restricted, so far as recorded, to this part of Western Australia. Mr. Etheridge, Jun., mentions a fossil comparable with this species, and from the above locality, in the Paxton collection of Western Australian fossils in the Department of Mines at Sydney.[2] It also occurs in the Gabriel collection from Geraldton, along with at least two other species of the genus.

In the present series there are portions of two left valves, one being fairly complete. The matrix from this and another shell (Trigonia) yielded numerous species of microzoa.[3]

Locality and Horizon.—Greenough River District, Western Australia. Jurassic. [2060-1.].

Trigonia, Bruguière.

Trigonia moorei, Lycett.

Trigonia moorei, Lycett, 1870 (in Moore's paper). Quart. Journ. Geol. Soc., vol. xxvi., p. 254, pl. xiv., figs. 9, 10.

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1 Besides the following series, I have described 7 spp. and vars. of Ostracoda, and 23 spp. and vars. of Foraminifera, from material out of the same collection. See antea, p. 185.

2 Ann. Rep. Dept. Mines, Sydney, for 1889 (1890), p. 239, Appendix No. 5c.

3 These form the subject of a separate paper.

This species, which was originally recorded from Western Australia, is represented by three specimens in the present collection. Two of these are rather young valves, the third is an adult form with the concentric ridges less prominent and, perhaps, partly worn down.

As an additional instance of the affinity of the Indian with the Australian Jurassic fossils, attention is drawn to the remarks by Dr. F. L. Kitchen respecting Trigonia dhosaensis. Referring to the relatively coarse, raised ornaments on the marginal carina, corresponding in number to the ribs of the flank, he says:—"It is a noteworthy fact that this feature is well developed also in T. moorei, Lycett, from Western Australia, to which T. dhosaensis shows other such striking points of resemblance as to suggest near affinity."[1]

Locality and Horizon.—Greenough River District, Western Australia. Jurassic. [2064-6.].

Pecten, O. F. Müller.

Pecten cinctus, Sowerby.

Pecten cinctus, Sowerby, 1823. Min. Conch., vol. iv., p. 96, pl. 371.

Moore, 1870. Quart. Journ. Geol. Soc., vol. xxvi., pp. 231, 232.

This is one of the fossils recorded by Chas. Moore, of Bath, England, from Western Australia, and which is well-known as an English Inferior Oolite fossil.

The solitary specimen of P. cinctus, in the Daintree and Gregory collection from the Greenough River District, is imperfect. Quite lately, however, the collection of Western Australian fossils in the Museum has been enriched by the donation of a series of Jurassic fossils from Geraldton, by Chas. Gabriel, Esq., which includes four specimens of this particular shell, thus enabling one to make a more satisfactory comparison of the Australian with the British examples.

When complete, the specimen from the Daintree and Gregory collection must have been about 16cm. in width; one example in the Gabriel collection measures even slightly more than that.

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1 Mem. Geol. Surv. India (Pal. Indica), ser. ix., vol. 3. pt. 2, No. 1, 1903, p. 113. For detailed comparison of the two species above-mentioned, see p. 31.

P. cinctus is recognized by the nearly circular outline, with fairly small, sub-equal auricles. The surface of the valves is broken up by thin, concentric laminae, more or less erect, and the shell is ornamented with fine, closely-set, radial striae. Auricles strongly marked with closely-set ridges, slightly flexuose. Right valve a little more convex than the left.

The outer layer of the shell has in some cases been almost entirely removed, and the intermediate layer shows weathered out on its surface a plexus of ramifying tunnels, now infilled with matrix ; they are most probably the work of a parasitic boring organism (? fungus), but coarser than either Duncan's Palaeachlya or Bornet and Flahault's Ostracoblabe. The average diameter of these tubes is about 0.4 mm. Besides this, there also occurs in one of the shells a much coarser kind of perforation, which does not confine itself to one layer of the shell but passes through at all angles, and its character makes it presumably referable to a boring sponge of the family Clionidae. Neither of these borings yield any residual structure which would assist in their identification.

Locality and Horizon.—Greenough River District, Western Australia. Jurassic. [2062].

Ctenostreon, Eichwald.

Ctenostreon pectiniformis, Schlotheim, sp.

(Pl. XXX., Fig 1).

Ostracites pectiniformis, Schlotheim, 1820. Petrefactenkunde, i., p. 231.

Lima proboscidea, Sow., 1821. Min. Conch. Gt. Brit., vol. iii., p. 115, pl. cclxiv.

Moore, 1870. Quart. Journ. Geol. Soc., vol. xxvi., pp. 231, 232.

Ctenostreon pectiniformis (Schloth.), Etheridge, Jun., 1901. Records Austr. Mus., vol. iv., No. 1, p. 14.

There is a left valve representing the above species in the Daintree and Gregory collection, which at first sight seemed to present almost specific differences from the specimens already figured by the above-named authors, and others mentioned in

Mr. Etheridge, Jun's. more copious synonymy in the Records of the Australian Museum.

The points of difference in our specimen consist in the greater length of the cardinal line as compared with typical British specimens[1]; in the strong and well-developed auricle at the anterior end of the hinge-line; and the sharper ridges, with pronounced tubular spines, formed by the intersection of costae with lamellae, especially towards the ventral margin. By Mr. Gabriel's donation I am enabled to compare the specimen now figured with similar fossils from Geraldton, which leads one to conclude that it is only an extreme variety of C. pectiniformis. The specimens in the Gabriel collection also show the variation in shell-sculpture in this species, due to the condition of the shell in relation to its preservation or decortication, the better preserved specimens usually having sharply ridged costæ.

Locality and Horizon.—Greenough River District, Western Australia. Jurassic. [2063].

Astarte cliftoni, Moore.

Astarte cliftoni, Moore, 1870. Quart. Journ. Geol. Soc., vol. xxvi., p. 249, pl. xiii., fig. 10.

A perfect specimen with united valves occurs in our series. Moore records it from the same locality.

Locality and Horizon.—Greenough River District. Western Australia. Jurassic. [2067.].

Cephalopoda–Ammonoidea.

Normannites, Munier Chalmas.

Normannites australe, Crick sp.

Ammonites macrocephalus, Moore (non Schlotheim), 1870. Quart. Journ. Geol. Soc., vol. xxvi., pp. 227–232, pl. xv., fig. 5.

Ammonites (Stephanoceras) australe, Crick, 1894. Geol. Mag., Dec. iv., vol. 1, p. 391, pl. xii., figs. 4*a*–4*b*.

Our specimen is fairly well preserved, but incomplete towards the extremity of the last whorl, and having the umbilicus filled

1 Exemplified in the Wright collection of Oolite fossils in the National Museum.

with a tenacious matrix. The suture lines are obscure. The present specimen is smaller than that described by Crick, having a diameter of 45 mm., and with the width measurement of the last whorl of 19 mm.

This species was recorded by Crick from the same locality as ours, and, as that author remarks,[1] it is evidently allied to Ammonites braikenridgii, Sowerby, and which, according to Munier Chalmas, is the type form of the genus Normannites. Moore's specimen evidently came from the same district as the above.

Locality and Horizon.—Greenough River District, Western Australia. Jurassic. [2068.].

Perisphinctes, Waagen.

Perisphinctes championensis, Crick.

(Plate XXX., Fig. 2).

Ammonites (Perisphinctes) championensis, Crick, 1894. Geol. Mag., Dec. iv., vol. i., p. 436, pl. xiii., figs. 2*a-c*.

The specimen figured by Crick is precisely similar to the present example in its essential characters, so far as the preservation of the latter enables one to see. The inner whorls are obscured by a tenacious matrix.

The dimensions of the present specimen are somewhat greater than those given by Crick, and are as follows:—

Diameter of shell	... ...	135 mm.
Width of umbilicus, about	...	45 mm.
Height of outer whorl ...	...	60 mm.
Thickness of outer whorl	...	46 mm.

An extremely interesting feature is exhibited in this specimen in the occurrence of the aptychus, lying towards the extremity of the last whorl of the shell and close against the ventral surface of the living chamber. It was revealed by the fracture and removal of one side of the outer whorl of the ammonite shell. One valve of the aptychus is nearly complete, with a portion of the adjoining plate; the apparent line of junction of the two halves in this instance is, however, misleading, as they are the

1 *Loc. cit.*, p. 392.

outer borders of the two valves, brought into approximation by pressure. The plates of this aptychus are rather thin, a usual character in those known to occur in the Perisphinctidae. In this example the aptychus has almost entirely lost the outer granular layer—all but one small patch lying near to the fractured shell of the ammonite. That which is probably the outer surface of the intermediate layer of the aptychus is smooth, sparsely and finely punctate, and the surface is traversed by curved, distant, slightly depressed folds or imbrications (in places). The granulate condition of the outer layer corresponds with Zittel's group, the Granulosi, to which the Perisphinctidae seem to belong.

Locality and Horizon.—Greenough River District, Western Australia. Jurassic. [2069.]

SPECIES RECORDED IN THE FOREGOING PAPER.

The asterisk denotes its occurrence for the first time from that locality.

Lepidodendron australe, McCoy. Carboniferous; Drummond Range, Q.

*Phyllotheca australis, Brongn. Carbo-permian; Baron R., Q.

*Archaeocalamites scrobiculatus (Schloth). Carbo-permian; Baron R., Q.

*Glossopteris browniana, Brongn. Carbo-permian; Baron R., Q.

*Glossopteris ampla, Dana. Carbo-permian; Baron R., Q.

*Glossopteris parallela, Feistmantel. Carbo-permian; Baron R., Q.

*Araucarioxylon daintreei, sp. nov. Carbo-permian; Baron R., Q.

*Stenopora leichhardti, Nich. and Eth., Fil. Carbo-permian; Irwin R. District, W.A.

Crinoid stems. Carbo-permian; Irwin R. District, W.A.

*Derbyia (*cf.*) senilis (Phillips). Carbo-permian; Irwin R. District, W.A.

*Strophalosia clarkei (Etheridge). Carbo-permian; Irwin R. District, W.A.

Productus undatus, Defrance. Carbo-permian; Irwin R. District, W.A,

Productus cora, d'Orbigny. Carbo-permian; (?) Bowen R. Coal Field, Q.

*Spirifer convolutus (Phillips). Carbo-permian; Irwin R. District, W.A.

*Spirifer (Martiniopsis) subradiatus, Sow. Carbo-permian; (?) Bowen R. Coal Field, Q.

*Sanguinolites (*cf.*) hibernicus, Hind. Carbo-permian; Irwin R. District, W.A.

*Allorisma (*cf.*) maxima (Portlock). Carbo-permian; Irwin R. District, W.A.

*Allorisma curvatum, Morris. Carbo-permian; Irwin R. District, W.A.

*Goniatites micromphalus (Morris). Carbo-permian; Irwin R. District, W.A.

Cucullaea semistriata, Moore. Jurassic; Greenough R. District, W.A.

Trigonia moorei, Lycett. Jurassic; Greenough R. District, W.A.

Pecten cinctus, Sow. Jurassic; Greenough R. District, W.A.

Ctenostreon pectiniformis (Schlotheim). Jurassic; Greenough R. District, W.A.

Astarte cliftoni, Moore. Jurassic; Greenough R. District, W.A.

Normannites australe (Crick). Jurassic; Greenough R. District, W.A.

Perisphinctes championensis, Crick. Jurassic; Greenough R. District, W.A.

EXPLANATION OF PLATES.

PLATE XXVII.

Fig. 1.—Lepidodendron australe, McCoy. Leaf cushions and vascular impressions. Carboniferous; Wynn Creek, Queensland. [1335]. × 3.

2.—Portion of the lower surface of leaf of Lepidodendron australe, with prominent mid-rib. Carboniferous; Drummond Range, Queensland. [2161]. Nat. size.

3.—A (?) sporophyll of Lepidodendron fruit (Lepidostrobus), associated with L. australe. Carboniferous; Drummond Range, Queensland. [2161]. × 3.

4.—Portions of four leaf-cushions on stem of Lepidodendron australe, showing at the extreme top of the lower

cushion a trace of the (?) ligule. The sub-epidermal surface with parenchymatous tissue. Carboniferous; Drummond Range, Queensland. [1376]. × 6.

5.—Portion of a stem of Lepidodendron australe, evidently from near the end of a terminal branchlet, showing fundamental parenchymatous tissue, traversed by strengthening plates of sclerenchyma. Carboniferous; Drummond Range, Queensland. [1376]. × 6.

6.—An imbricated (?) terminal bud, possibly belonging to Phyllotheca australis, or to Archaeocalamites scrobiculatus. Carbo-permian; Baron River, Queensland. [2167]. × 2.

7.—Strobilus of Phyllotheca australis, attached to a whorled leaf-sheaf. Carbo-permian; Baron River, Queensland. [1381]. × 4.

8.—Part of stem of Archaeocalamites scrobiculatus. Carbo-permian; Baron River, Queensland. [1381]. Nat. size.

9.—Portion of the nodal area of Archaeocalamites scrobiculatus, with leaf scars. Carbo-permian; Baron River, Queensland. [1381]. × 4.

Plate XXVIII.

Fig. 1.—Araucarioxylon daintreei, sp. nov. Stem transversely fractured, showing growth rings of the xylem extending close to the centre. [2235]. Nat. size.

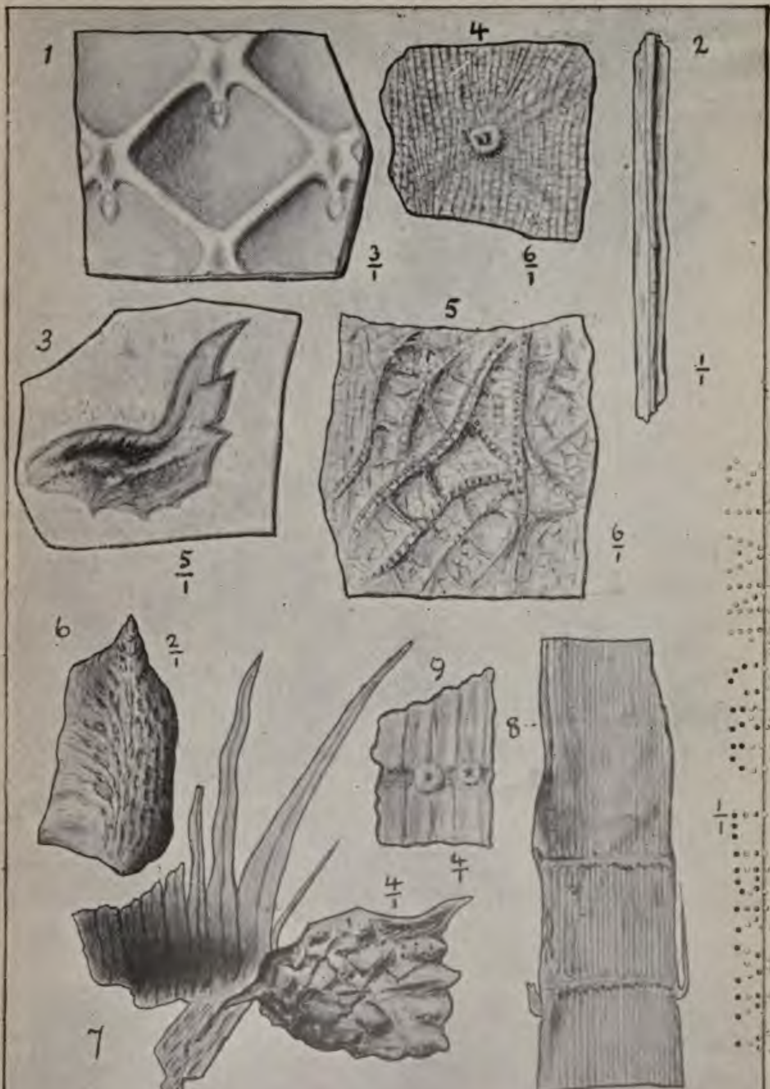
2.—A. daintreei, sp. nov. Transverse section of wood. × 180.

3.—A. daintreei, sp. nov. Radial section of wood, showing pitted tracheides. × 180.

Plate XXIX.

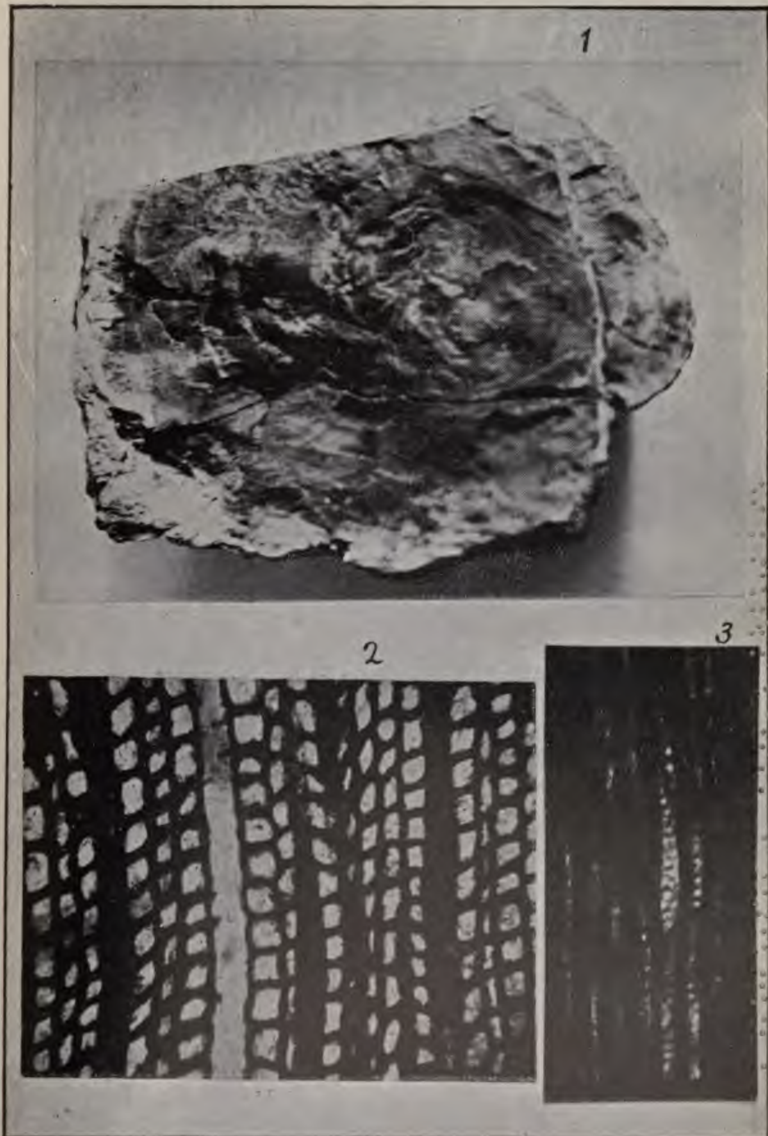
Fig. 1.—Araucarioxylon daintreei, sp. nov. Radial section of wood. × 180.

2.—A. daintreei, sp. nov. Tangential section of wood. × 180.



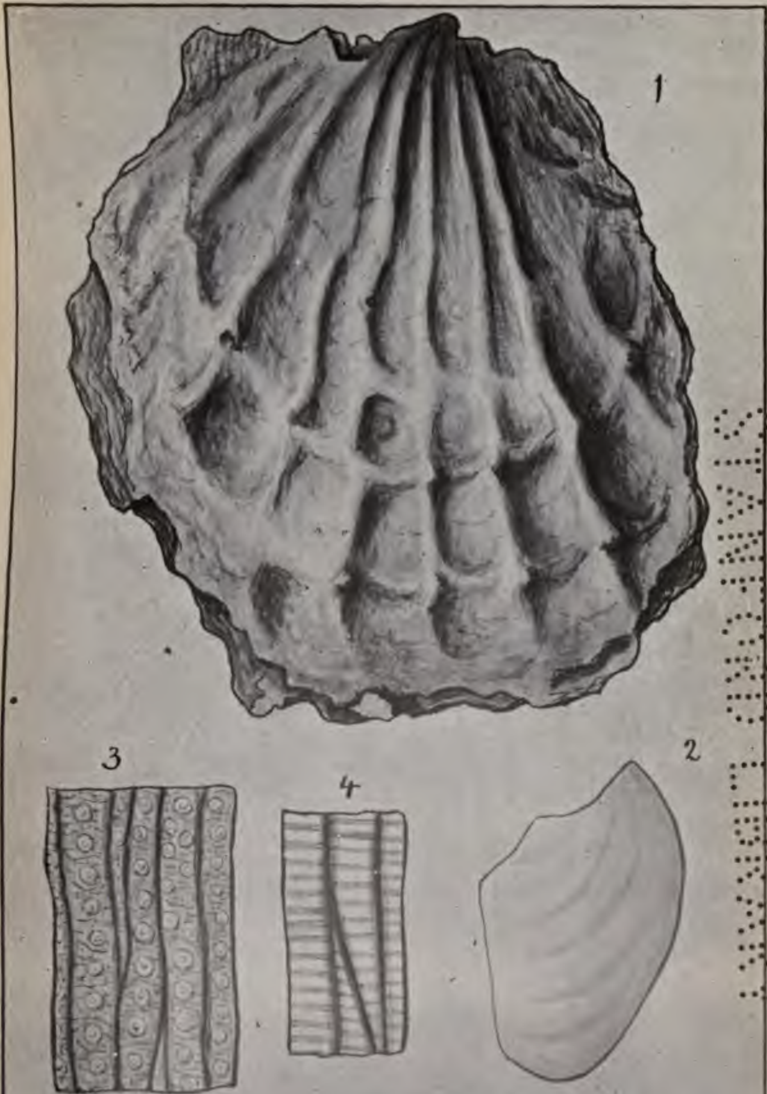
F.C. *delt.*

West Australian and Queensland Fossils.



F.C. delt.

West Australian and Queensland Fossils.



F.C. delt.

West Australian and Queensland Fossils.

3.—A. daintreei, sp. nov. Radial section of wood from the centre, showing pith cells. × 180.

Plate XXX.

Fig. 1.—Ctenostreon pectiniformis. Schlotheim, sp. Left valve. Nat. size. [2063].

2.—Perisphinctes championensis, Crick. One-half of aptychus. Nat. size. [2069].

3.—Araucarioxylon daintreei, sp. nov. Radial section of wood, showing tracheides with bordered pits. × 230.

4.—A. daintreei, sp. nov. Radial section, showing scalariform tracheides of the protoxylem. × 230.

Art. XIX.—*New or Little-Known Victorian Fossils in the National Museum.*

Part III.—Some Palaeozoic Pteropoda.

By FREDERICK CHAPMAN, A.L.S., &c.,

National Museum.

(With Plate XXXI.).

[Read 8th December, 1903].

With regard to the zoological relationship of the fossils described in this paper there is much diversity of opinion, and they are here referred to the Pteropoda with a certain amount of reserve. Nicholson has shown that by the presence of a bulbous commencement or protoconch, Tentaculites, one of the genera now described, seems to bear a decided relationship with the more recent pteropods, as Clio. The absence of any signs of attachment to a foreign body which might be seen on the shell, as well as its general structure, precludes one from referring the typical Tentaculites to the Tubicolar Annelides, as some have done.

Haeckel and Pelseneer, on the other hand, exclude all pre-tertiary forms from the group of the Pteropoda.

So far as the present evidence goes, the Palaeozoic examples of Styliola and Tentaculites seem to be, zoologically, closely related, the former genus being usually distinguished by the absence of annulations on the shell-surface, and it is either smooth or striated transversely. In Tentaculites the shell-wall is, as a rule, much thicker, although some species have quite a thin shell, as, for example, that now described under the name of T. matlockiensis.

The species of Hyolithes described in this paper belong to the genus in its restricted sense; that is to say they have the margin of the flattened side of the shell projecting considerably beyond the opposite wall.

The species described here from the Melbournian series are:—

Coleolus (?) aciculum, J. Hall.

Hyolithes novellus, Barrande.

„ spryi, sp. nov.

Conularia ornatissima, sp. nov.

From the Yeringian series—

Conularia sowerbii, Defr.

From beds probably higher in the series than the preceding—

Styliola fissurella, J. Hall, var. multistriata, var. nov.

Tentaculites matlockiensis, sp. nov.

On examining the above list, but excluding the Styliola and Tentaculites, which occur on a higher horizon, one is struck with the mixed character of the Silurian fauna in and around the Melbourne area.

Two of the species recorded, viz., Hyolithes novellus and Coleolus (?) aciculum are found elsewhere—in Bohemia and North America—in Devonian strata. Another is closely related to an Upper Ordovician form, whilst one species cannot be separated from the well-known Conularia sowerbii, which ranges from the top of the Ordovician (Bala beds) to the Ludlow series in Britain.

Genus **Styliola**, Lesueur.

Styliola fissurella, J. Hall, var. multistriata, var. nov. (Plate XXXI., Figs. 4–6).

Description.—The shell is in the form of a slender, tapering cone, with a minute bulb at the apical end. The Victorian specimens cannot be separated specifically from Hall's S. fissurella,[1] but differ from it in a varietal manner, by having the surface marked with very fine and regular transverse lines of growth. The Victorian specimens average about 2.5 mm. in length. The American specimens are very variable as to ornament, but they do not show so constant a character in the lineation of the shell as do our specimens.

The shells as they occur in the shale are somewhat flattened, but, from the fact of their being so minute, they have sometimes

1 **Tentaculites fissurella, J. Hall.** Geol. N.Y. Surv., Fourth Geol. Distr., 1843, p. 180, figs. 9 and 10; p. 222, fig. 4.

Styliola fissurella, Hall. Pal. N.Y., vol. v., pt. ii., 1879, p. 178, pl. xxxiA., figs. 1-30.

escaped compression. The upper half of the shell is marked by a longitudinal median depression or fracture.

The species itself was originally recorded from the Marcellus shale, and the lower part of the Hamilton group, in the States of New York and Indiana.

Occurrence and Horizon.—This variety is found in great abundance in the bluish-grey shales of McMahon's Creek (from the Department of Mines, 3778). [1185 and 2357-60]. Also from the hard blue shales at the mouth of Starvation Creek (Department of Mines, 3368). [2361]. Both are from the Upper Yarra district. Some of the rock specimens are largely composed of these tiny shells. The latter are usually superficially stained by limonite, which causes them to stand out in contrast to the matrix of the rock. Siluro-devonian or Devonian.

Genus **Tentaculites**, Schlotheim.

Tentaculites matlockiensis, sp. nov.

(Pl. XXXI., Figs. 1, 2, 3, 5).

Description.—Shell conical, tapering, but broader at the open end than is usual in this genus. Shell substance thin, as in Styliola, but having distinct annuli, as in the typical forms of Tentaculites. Apical portion bulbous, sometimes apiculate, and occasionally with an overhanging flange. Margin of the orifice undulate, and with a vertical slit or sinus in a line with the median depression of the shell-surface. A transverse section of the shell shows it to be thinner in the neighbourhood of this depression, and the example figured (Fig. 5) has a tubular enclosure which has the appearance of a small siphuncle or ventral canal. The proximity of this tube to the wall of the shell seems, however, to be unfavourable to the idea of its relationship to the Cephalopoda, to which it might otherwise point. On the other hand examples are not unknown where a smaller shell is found enclosed in an adult specimen, and from the relative diameter of our section, the slice was apparently taken across the shell, not far from its apical end, where the enclosed shell would have a much smaller diameter.

The first third of the shell is generally smooth, afterwards becoming annulated with thin salient ridges, the intercostal

spaces being concave. The annuli cease near the marginal extremity, and the shell-surface bears numerous, vertical, superficial wrinklings pointing to an affinity with the vertically striated species of the genus.

Observations.—This species resembles T. gracilistriatus, J. Hall,[1] in the breadth of the distal end of the shell, but is devoid of the fine longitudinal striae seen in that species. In its neat and rather closely annulated shell-surface T. matlockiensis approaches T. bellulus, Hall[2]; but the latter form is always much more slender.

Occurrence and Horizon.—In the slaty shales of Mount Matlock; presented to the National Museum by Mr. N. Lepoidivil. [1131-2]. Siluro-devonian.

Genus **Coleolus**, J. Hall.

Coleolus (?) **aciculum**, J. Hall. (Plate XXXI., Fig. 7).

Coleolus aciculum, J. Hall, 1879. Pal. N.Y., vol. v., pt. ii., p. 187, pl. xxxiiA., figs. 11-15.

Observations.—In the series of Silurian fossils obtained during the work of the Yarra Improvements excavations, there are at least two specimens which are in all probability referable to the above species. Both specimens have lost the slender aciculate extremity, and are therefore regarded as similar to Hall's species only in a provisional sense, in the absence of complete specimens.

The angle of divergence of the lateral margins of the shell, and the faint and irregular surface markings, tend to confirm its identification with C. aciculum, which was described from the N. American Devonian (Genessee Slates).

Occurrence and Horizon.—Found in the blue and yellow mudstones at South Yarra, and near Prince's Bridge. Collected by Mr. F. Spry. Silurian (Melbournian). [1130 and 1174].

Genus **Hyolithes**, Eichwald.

Hyolithes novellus, Barrande. (Plate XXXI., Fig. 8.)

Hyolithes novellus, Barrande, 1867. Syst. Sil., vol. iii., p. 86, pl. xv., figs. 23–24; pl. xvi. (?), fig. 18.

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1 J. Hall, Pal. N.Y., vol. v., pt. ii., 1879, p. 173, pl. xxxi., figs. 12, 13, 14; pl. xxxiA., figs. 37-47.

2 *Loc. sup. cit.*, p. 169, pl. xxxi., figs. 15-18; pl. xxxiA., figs. 48-51.

Observations.—Our specimens closely agree with Barrande's figured specimens. H. novellus is one of the few longitudinally striate forms of the genus. The angle of divergence is about 20°. Barrande's specimens were from Stage G. (Lower Devonian) of the Bohemian area.

Occurrence and Horizon.—Found in the bluish-grey mudstone out of the shaft in the tunnel of the Reservoir at Yan Yean.

Coll. Geol. Surv. of Victoria, Bb 13. Silurian (? Melbournian). [1123-4].

Hyolithes spryi, sp. nov. (Plate XXXI., Fig. 9).

Specific Characters.—Shell conical, straight, or with a slight curvature to one side, extremely sharply pointed. Lateral margins acute, having an angle of divergence of about 21°. Surface of shell marked with fine, tranverse and arched growth lines, and occasional broader and slightly convex bands. Operculum sub-elliptical, ventral edge regularly curved. The umbo is situated at $\frac{5}{8}$ of the width from the base. There is a distinct fold proceeding from either side of the umbo to the lateral margins. Surface of operculum concentrically and finely striate. Length of figured shell, 23 mm.; breadth at aperture, 9 mm.

Observations.—The form of the shell in this species is somewhat like that of H. elegans, Barrande, an Upper Ordovician form.[1] It differs, however, in being straighter, in having a less dilated aperture, and in the details of its ornament; there being no longitudinal markings on the surface of H. spryi.

Occurrence and Horizon.—Found in the dark argillaceous rock of Domain-road, South Yarra. [1127-9; 1121-2]. Collected and presented by Mr. F. Spry. Also in the bluish mudstone, near the Botanical Bridge, South Yarra (Yarra improvements). [1120]. Collected by Mr. F. Spry. Silurian (Melbournian).

Genus **Conularia**, Miller.

Conularia sowerbii, Defrance. (Plate XXXI., Figs. 8, 10, 11, 12).

Conularia sowerbii, Defrance, 1825. De Blainville, Man. Malac., p. 378; atlas, pl. xiv., fig. 2.

1 Syst. Sil., 1867, vol. iii., p. 81, pl. xi., figs. 14-25.

C. sowerbii, Defr., Salter, 1859. In Murchison's Siluria, p. 550, pl. xxv., fig. 10.

C. sowerbii, Defr., de Koninck, 1898. Mem. Geol. Surv., N.S.W., Pal. No. 6., "Pal. Foss., N.S.W." p. 34.

Observations.—This is a comparatively broad form of Conularia, well-known from Upper Ordovician to Silurian strata in Europe and elsewhere. It has also been recorded with reservation by de Koninck from Rock Flat Creek, New South Wales (Silurian).

Occurrence and Horizon.—In the hard grey mudstone at the junction of the Woori Yallock and the Yarra: coll. Geol. Surv. Vict., B 23 [1125]. Also in the ochreous mudstone of Wilson's, N. of Lilydale. [2362-3]: presented by Mr. J. T. Jutson. Silurian (Yeringian, and perhaps younger).

Conularia ornatissima, sp. nov. (Pl. XXXI. Figs. 13, 14).

Specific Characters.—Shell broadly conical, with blunt and rounded apex; angle of divergence about 50°. Transverse striations fine, and strongly arched; at 10 mm. from the apex, 0.2 mm. apart. The intercostal striae fine, and traversing the transverse ridges. Length of figured specimen 18 mm.; but indications on matrix of one example point to its having had a much greater length.

Observations.—This Conularia belongs to the type of C. nobilis, Barrande[1] from the Upper Ordovician of Bohemia (Stage D). In our species, however, the vertical ornament is not so pronounced, and therefore it does not appear as though the shell were continuously striated from apex to mouth. The interspaces between the vertical costulae are wider than in C. nobilis.

Occurrence and Horizon.—In the blue and yellow mudstones at South Yarra (Yarra Improvements). [1186, 2361]. Collected by Mr. F. Spry. Silurian (Melbournian).

CORRIGENDA TO PART II., Vol. XVI., Pt. I., 1903.

P. 65, line 7 from bottom, for [59] read [597].

P. 69, line 7 from bottom, after figs. 6, 7, insert pl. xii., figs. 1-9.

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1 Syst. Sil., 1867, vol. iii., p. 46, pl. xiv., figs. 7, 8.

P. 60, line 3 from bottom, after fig. 5, insert pl. xii., fig. 2.
P. 72, line 6 from bottom, for [678-81] read [678-80].
P. 79, line 15 from top, for tribolite read trilobite.
P. 79, line 16 from top, for faces read facies.

EXPLANATION OF PLATE XXXI.

Fig. 1.—Tentaculites matlockiensis, sp. nov. [1131]. × 14.

2.—T. matlockiensis. sp. nov. Apical portion with protoconch, seen in section. × 56.

3.—T. matlockiensis, sp. nov. Apical portion of another example, with a differently shaped protoconch, from a section. × 56.

4.—Styliola fissurella, Hall, *var.* multistriata, var. nov. [2357]. × 14.

5.—Tentaculites matlockiensis, sp. nov. A transverse section taken in the earliest third of the shell. Showing a tubular enclosure. × 56.

6.—A piece of shale from McMahon's Creek, showing the relative abundance of the shells. Natural size.

7.—Coleolus (?) aciculum, Hall. [1130]. Natural size.

8.—Hyolithes novellus, Barrande. [1124]. × 2.

9.—H. spryi, sp. nov. With operculum *in situ*. [1127]. × 2.

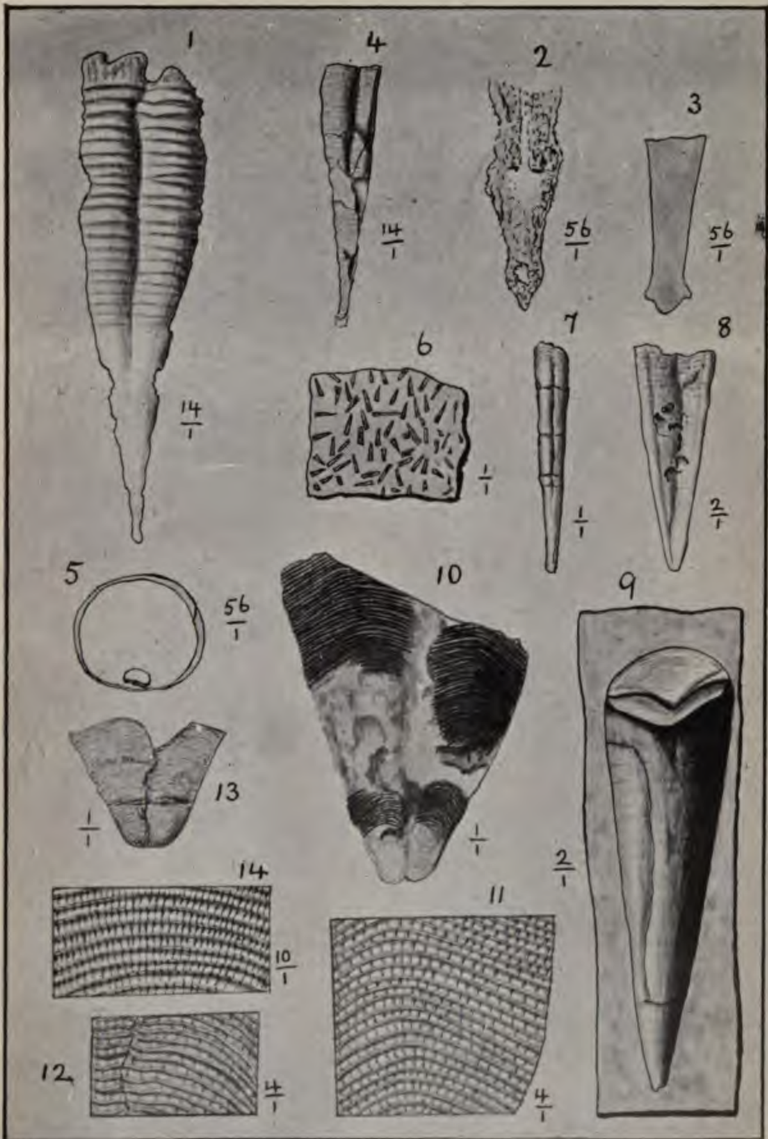
10.—Conularia sowerbii, Defrance. [1125]. Natural size.

11.—C. sowerbii, Defrance. Ornament magnified, and partially restored. × 4.

12.—C. sowerbii, Defrance. Ornament from another, better preserved specimen. [2362]. × 4.

13.—C. ornatissima, sp. nov. [1186]. Natural size.

14.—C. ornatissima, sp. nov. Ornament magnified. × 10.



F.C. delt.

Palaeozoic Pteropoda.

Art. XX.—*On an Unnoticed Feature of the Faulting at Ballarat East.*

By T. S. HART, M.A., F.G.S.

(With Plate XXXII.).

[Read 8th December, 1903].

The Ballarat East Goldfield has been described by Mr. Ernest Lidgey, in a Special Report issued by the Department of Mines, Victoria, in 1894.

The faults are there grouped as follows:—

- Faults which occurred before and during the time when quartz veins and lodes were being formed.
- Faults which occurred after the quartz veins and lodes were formed, including—
  - Strike faults coinciding with the bedding planes.
  - Strike faults, or slides, crossing the strata in their dip. These are always reversed faults.
  - Dip faults or crosscourses.

It is to the nature of the movement on these dip-faults, or crosscourses, that I now wish especially to call attention.

Some 46 of these crosscourses are shown on a plan accompanying Mr. Lidgey's report.

He notices with reference to them that they are more recent than any of the other faults; that the down-throw is on the hanging wall side, and they are consequently normal faults, and that the apparent heave is always on the side of the greater angle, that is, the greater angle in a plan of the intersection of crosscourse and strata.

More recent observations corroborate these conclusions; but an unusual case seems to occur in the North Woah Hawp Co., of a small apparent heave in the other direction, and possibly may also occur on a few crosscourses whose strike is nearly at right angles to that of the strata.

For a number of these crosscourses the amount of the "apparent throw" and "apparent heave" is stated in a list in Mr. Lidgey's report.

Now, if it be remembered that the strata are ordinarily nearly vertical, and that the crosscourses are usually nearly vertical, it will easily be seen that the recorded throws are quite inadequate to produce the recorded heaves. The figures recorded as "apparent throw" seem to represent the actual vertical component of the displacement, as measured by the difference of level of the intersections of a recognisable vein with the indicator on the two sides of the crosscourse. Also, if the strata were actually vertical, a crosscourse, whatever its inclination, would necessarily produce a heave towards the smaller angle in plan if the real movement were a downward movement of the hanging wall in the direction of the dip of the crosscourse. (See Fig. 2).

If the strata were not quite vertical with the same movement the heave would at first diminish till it disappeared, and with a further departure of the strata from the vertical, would become an apparent heave in the opposite direction.

If the strikes of strata and crosscourse make an angle of 60° with one another, strata with a dip equal to that of the crosscourse would be heaved towards the greater angle to the same amount as vertical strata would be heaved toward the smaller angle in plan.

From these facts we must conclude that the movement has not been a downward movement of the hanging wall side in the line of dip of the crosscourse. The vertical component of the movement is indeed, at least usually, downward on the hanging wall side; but it does not even approximately represent the whole actual movement. The description of the crosscourses as normal faults is therefore not incorrect, but is certainly quite inadequate.

It is possible that this is the reason why the term "apparent throw" is used in Mr. Lidgey's report. The alternatives of incorrect correlation of the strata, undetected repetition, or exceptional dips are quite out of the question. They could not explain a consistent feature of so many crosscourses throughout the field.

The "apparent throw," then, represents the actual vertical component of the displacement. The "apparent heave" is, however, composed of two parts, one of which, relatively small, is consequent on this vertical movement, and the other, relatively large and usually in the opposite direction, is due to an actual horizontal component of the displacement on the fault.

It is not uncommon for the "apparent throw" and "apparent heave" to be about equal, though the throw is in some cases much less. The following table gives approximately the amount of the heave due to the vertical displacement and the amount of the observed heave, and the amount of heave due to the horizontal movement as deduced from these. No. 21, being a north-westerly crosscourse, shows a left-hand heave, the others are north-easterly and show a right-hand heave.

Crosscourse.	No. 3.	13.	19.	21.
"Apparent throw" -	150	60	4	14
Consequent heave - -	10 left	7 left	.03	1 right
Observed heave - -	180 right	80 right	4	14 left
Heave due to horizontal movement - -	190 right	87 right	4	15 left

In addition to these it may be noted that on the great crosscourse No. 34, 100 feet vertical displacement would give only 6 feet heave, and that to the left if the hanging wall had gone down. The observed heave is 612 feet to the right. In No. 19, 100 feet vertical displacement would give less than a foot heave, but in No. 37, where the conditions are such as to produce an unusually large heave, the same vertical displacement would give about 58 feet heave in vertical strata, with the ordinary average strike of this field.

Crosscourse No. 23 is noted by Mr. Lidgey as producing the same heave, on the indicator, and on four crosscourses intersected by it. This result could only be due to horizontal movement, but the heave is small, and appears to be irregular in amount.

The evidence of the slickensides.—The walls of the crosscourses and partings parallel to the walls in the fault-rock are often well striated. These can usually be seen running in a variety of directions, but on the crosscourses the most marked and most persistent seem generally nearer to a horizontal direction than to the line of dip of the surfaces, and are often almost horizontal. The evidence of the striations supports the deductions from the apparent throw and heave, but is itself less consistent, owing, no doubt, to the fact that strong striations may result from a single movement which may be itself of small importance compared with the whole movement, and different in direction.

It is noticed by Mr. Lidgey, that the north-easterly crosscourses of this field are most numerous and appear most important, several of them have larger displacements than any known north-westerly crosscourse. On the north-easterly crosscourses, the hanging wall side has generally a relative movement downward and forward in a south-westerly direction. This is the general direction of dip of most of the slides. The crosscourses are, however, newer than the slides and displace them, but the existence of the slides may have facilitated the movement in this direction, and contemporaneous further movement on the slides might easily produce an abrupt change in the displacement on the crosscourses.

The other faults.—The slides are in all cases reversed faults, and the strata are usually much bent near them. If we regard the strata as vertical and the movement as along the line of dip of the fault, then the heave due to any throw = throw × co-tangent of angle of inclination of fault to horizontal plane × cosine of angle between strikes of fault and strata. As the angle of inclination of the fault is usually about 45°, and the angle between the strikes usually less than 10°, both these ratios are nearly unity, and we would expect to find throw and heave about equal, as they are by observation. But it does not appear how the throw has been ascertained; if it is simply the difference of level of the two points in a vertical plane at which the indicator (or any other bed) meets the fault from the upper and lower sides, then it must necessarily agree with the apparent heave of the same bed, for (as is shown later by Fig. 1), the two quantities are not independent. Similar remarks apply to other strike-faults of which the direction and dip are different. The observed facts are in any case not inconsistent with a typical reversed fault, and the striations, in some cases at least, support the view that the motion has been in the direction of the line of dip of the fault.

There does not appear to be any very real difference between these slides and those which occurred prior to the formation of the quartz reefs, some of which are themselves occupied by quartz reefs. The periods of formation of the strike faults and of the quartz veins and lodes appear to have overlapped.

Effect of the crosscourses and other faults on the position of rich ore.

The change of value or dimensions of ore on crossing a fault are in many cases directly due to the fact that the ore, where first recovered, is not the part severed from that portion of the lode at which the fault was met. At Ballarat East, however, the actual veins lost are usually recoverable at no great difference of level on the other side of a crosscourse. The difficulty in ascertaining the throw is often due to the large number of veins of not very different character, and the fact that in working they are soon removed. The correct correlation of rich and poor portions in neighbouring fault blocks can only be made by taking account of the actual movement.

The indicator belt as at present known terminates abruptly at Crosscourse No. 1, Black Hill. It seems unlikely that any rich continuation on the surface could have so long escaped detection. It may be that the faulting has brought up to the surface level a poor portion of the indicator. [Some of the veins crossing the indicator run from a slide on which may be a "main lode." Such series of veins form oblique bands, and, if the slide is too far from the indicator, may not reach it at all, though they may be worked on other slates. Some of the unworked portions of the indicator are due to this arrangement, and some very rich specimens recently found at the North Woah Hawp Co. were found where one of these slides crossed the indicator]. Another explanation of its absence may be that strike faults, being reversed faults, leave a gap in the indicator between certain levels. If the fault and strata have almost the some strike a particular bed or series of beds may be absent at the surface for a long distance.

Geometrical constructions to ascertain the true movement on the fault, or to recover a lost lode, or other deposit, displaced by a fault.

In Figs. 1 to 4, supposed drawn on a horizontal plane:

Let ROF be the line of strike of the fault;

DO the line of strike of the lode on the side where already known;

RE the position of the lode on the other side of the fault;

OI, RJ the projections on the horizontal plane of the lines of intersection of the two parts of the lode with the fault.

[For convenience, the word "lode" will be used for the faulted deposit, except where some special case is referred to. The

construction will apply equally to a bed or to an older fault-line].

The arrows on the lines of strike represent direction of dip; those alongside other lines represent the direction of inclination of the inclined lines, which these lines on the plan represent.

ON drawn at right angles to OF is the projection on the horizontal plane of the line of dip of the fault.

OI may be thus ascertained: Take a point B on OF, and make angles OBA, OBC, equal to the angles which the fault and the lode respectively make with the vertical. Then in a height OB the fault and lode will move in the directions of their dips to distances measured on a horizontal plane by OA and OC respectively. Draw lines (shown by dotted lines in Fig. 1) parallel to OF and OD, and at distances from them equal to OA, OC respectively. Their intersection is a point on the intersection of the lode and fault, which can be then at once drawn. If there is no rotation round an axis perpendicular to the plane of the fault, the dip and strike of the lode beyond the fault should be unaltered (neglecting any bending due to the movement, as is done here throughout), RJ is therefore parallel to OI. If there has been rotation, RJ needs to be plotted independently.

Then, since RJ represents all points on the intersection of the fault and the lode beyond the fault, the point once in contact with O must have moved to some point represented in plan on the line RJ.

If the movement has been down the line of dip, this point will be given by M (on the line ON), otherwise it may be at some other point such as Q. OQ represents, on plan, the movement of the point once in contact with O.

To determine Q.: On the crosscourses at Ballarat East it is often possible to ascertain directly the difference of level of the points at which some recognisable vein crosses the indicator on the two sides of the crosscourse. This is the true throw or vertical component of the movement. If OB be taken equal to this throw, then OA represents the amount of displacement on plan in the direction of the dip, and if AQ be drawn parallel to OR to meet RJ in Q, the true movement is thus determined as a true throw = OB, and a true lateral displacement = AQ. Fig. 1 shows a general case; Fig. 2, the particular case of a vertical lode or bed. Fig. 2 represents the case at Ballarat East, and it

will be seen that the vertical movement alone would give an apparent lateral displacement OW, whereas the observed lateral displacement is almost always in the opposite direction. [For clearness in the figure, OA is much larger, compared with AQ, than in most actual cases at Ballarat East].

The construction in Fig. 3: Ascertain Q by the observed heaves of two non-parallel lodes (lode and beds, etc.). Od, OD represent their directions of strike, not necessarily actual position. Or, OR their observed amounts of displacement along the fault. Rj, RJ the lines of intersection with fault of their parts beyond the fault. If these meet at Q, the true direction of movement is shown on plan as OQ, and may, if desired, be resolved into two components as before.

From Fig. 4, which represents a case where there has been rotation, it will be seen that two points, O, I, are not displaced, either to the same amount or in the same direction. The determination of a rate of variation of both components of the movement may be made by sufficient observations, and it is evident that either or both components may at some point vanish, and will do so if other conditions remain the same for a sufficient distance.

The same constructions may be used when the motion on the fault is known in direction or amount, or both, to ascertain the direction and distance at which the lode may be recovered on the same level as the point at which it was lost.

Zimmerman's rule depends on a construction of this kind. If the line of intersection OI and a perpendicular ON to fault-line be both drawn forward into the unknown ground, the lode is to be sought on that side of the line of intersection on which this perpendicular falls. This is illustrated in Fig. 1, where it gives the correct direction, and in Fig. 2, where it would give the wrong direction.

Fig. 3 also at once shows that, if the lateral displacement of the lode OD is observed as OR, and it is desired to ascertain that of Od, it is not immaterial to which point on RJ we suppose the point from O to have moved.

Zimmerman's rule is, in fact, dependent on the following assumptions:—

(i). That the relative movement of the hanging wall side has been downward on the line of dip of the fault (that is, that it is represented on plan by ON).

(ii). That there has been no relative rotation about an axis perpendicular to the plane of the fault.

(iii). That there has been no alteration of shape which would make the two blocks no longer correspond to one another.

A modified rule has been suggested by Mr. J. T. Freeland (Trans. Amer. Inst. M.E., vol. xxi.). "After cutting through the fault prospect on that side of the line of intersection of the known parts of the vein and fault, indicated by the relative motion of the opposite block of ground for the extension of the vein and the second line of intersection." The first line of intersection is here drawn towards the unknown ground, and the "relative motion of the opposite block" is indicated by its projection on the horizontal plane of the diagram (the line OQ on the figures).

This completely disposes of the first assumption, and hence gives the correct direction in the case of Fig. 2. The second assumption is also disposed of if it is possible to ascertain the direction of the line of intersection (on plan) of the fault with the lost part of the deposit.

It seems better, however, to use a geometrical construction without putting it as a rule, as this tends to the forgetting of assumed conditions.

The lode and fault being plotted as DO, OF, draw OQ representing the projection on the horizontal plain of the direction of movement, and QR parallel to the projection of the line of intersection of the fault and the lost portion of the lode. Let QR meet FO in R, then OR is the direction in which to seek the lost lode, and if OQ represents the amount of the movement, OR represents, on the same scale, the distance to be driven.

The absence of rotation in stratified rocks is usually at once ascertainable as soon as settled ground is reached beyond the fault. If there has been rotation, the line of intersection is easily plotted in the case of bedded rocks, or of a lode parallel to the beds, but for other cases may be more easily given by another construction following. If the rotation is small it can often be neglected, but may affect the direction to be driven when the line

of intersection and the direction of movement make only a small angle with one another.

The direction of striations, if sufficiently decisive, may be used to determine the direction of movement—determining the ratio of OB to AQ.

The diagram on a horizontal plane is especially useful in working lodes; as DO, OR, RE usually represent actual drives, and the line of intersection is sometimes ascertained by the positions of lode and fault at a lower level.

Plans on the plane of the fault may also be used, and are chiefly convenient as showing at once on the diagram the angle which the striations should make with the horizontal line in the fault, and for the ease with which they deal with rotations, though Mr. P. Lake, who uses this construction to ascertain the true movement on a fault (Geol. Mag. 1897) states that in the case of a rotation the problem is insoluble.

Figs. 5 to 8 illustrate such diagrams.

OF is a horizontal line in the fault-plane.

OH, RL are traces of the planes of the lode on the fault-plane.

OP is the direction and amount of movement.

In Fig. 5, OD, OI, drawn as on a horizontal plane with OF, represent the strike of the lode and the projection of its line of intersection.

IG is drawn perpendicular to OF, FI making angle GFI equal to the inclination of the fault to the vertical, GH = IF. Then OH is determined. In the absence of rotation RL is parallel to OH.

If, however, it is found that on passing the fault the trace of otherwise parallel bedding planes is altered from OH to OK, this rotation, due to movement on the fault, will affect also to the same amount lodes, etc., crossing these beds. A lode, whose trace on this side of the fault was parallel to PT (Fig. 6) will be turned to Pr.

The true movement is ascertainable as before. Fig. 5 represents the case of a horizontal recognisable vein crossing the bed, represented by OH. UV evidently represents the actual movement, and is easily resolved into two components as before.

Fig. 7 represents two non-parallel lodes. OH, Oh, the directions of their traces on this side of the fault OR, Or, the

amount of their observed displacements along the fault. RP, rP, the directions of their traces on the fault plane on the other side. Then the true movement is given by OP. Mr. P. Lake uses this construction for the displacement of an anticline. Rotation presents no difficulty in bedded rocks, for its amount is at once ascertainable, and if there had been observed displacement to OS, os, with a rotation represented by the angle SPR, or sPr, the construction to fix P would be still as easily made.

Fig. 8 represents a diagram to deduce the movement of a point X from that of O, when there is rotation the line OX may be supposed displaced parallel to itself to PZ, and then rotated about P to PY, then XY will represent the actual movement of the point once in contact with X, the rotation remaining the same.

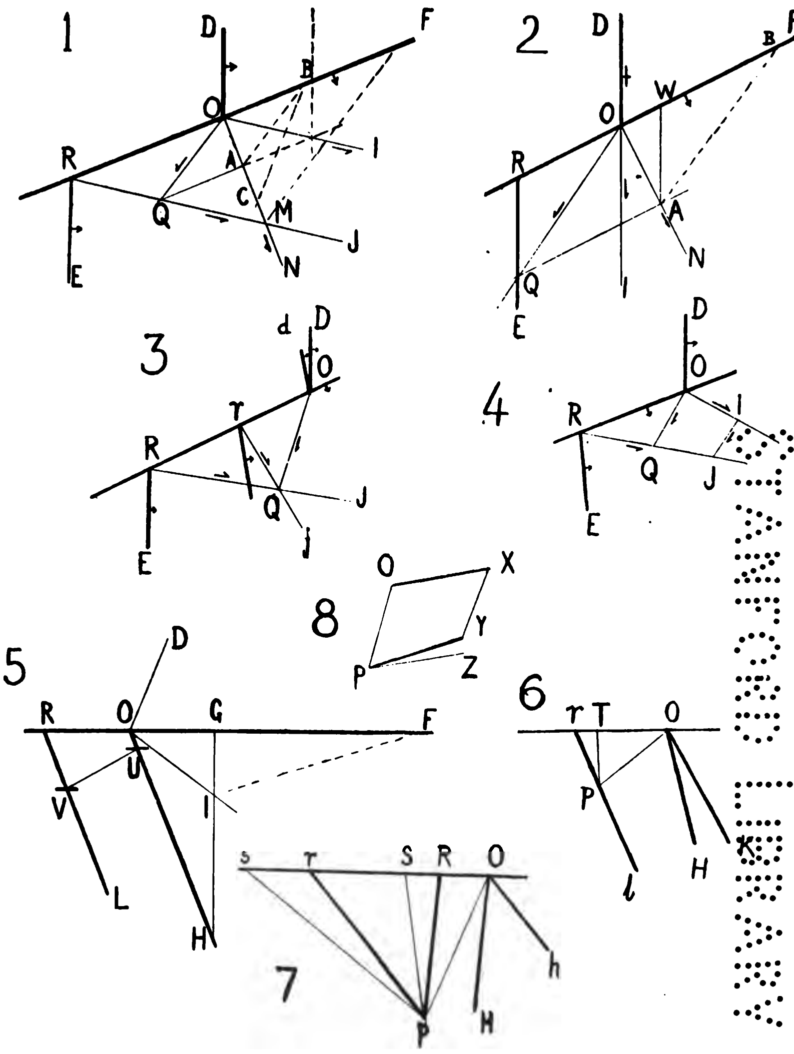
Cases of alteration in shape of either block (as by a fault meeting the first fault, or any other cause) need to be each treated as suits the individual case. In the case of intersecting faults it may be convenient to examine the movement along and at right angles to their line of intersection.

The complete description of the movement in a fault comprises three parts—the throw, the true lateral displacement, and the rotation. With a rotation, the throw and lateral displacements will vary from point to point, and all may vary with an alteration of shape of one block either gradually or suddenly.

Formulae for calculation might be given for all these cases, but the calculation would be usually more troublesome than the diagram, and the diagram can be easily made as accurate as the data themselves, on which a calculation would have to be based.

A case is, perhaps, worth referring to which may occur, but is scarcely a true case of faulting. It may happen that the deposition of lode matter has gone on under similar conditions in two fractures meeting a fault from the two opposite sides. The lodes produced may be similar; the fractures which they occupy are independent, and there may be apparently throw, heave, or rotation, whereas really there is only a similarity between two distinct lodes occupying fractures which never have corresponded.

The crosscourses of other fields have not been described with the same detail as those of Ballarat East. It seems, however, that a similar oblique motion, as might be expected, is found in



Fault Diagrams.

the crosscourses in the Ballarat West line at Sebastopol, some of which are no doubt identical with those of Ballarat East. A crosscourse with large but uncertain displacement occurs near where the great crosscourse would be expected.

Mr. Dunn notices evidence of striations showing horizontal movement on Coleman's Fault at Bendigo (Report on Bendigo Goldfield, Mines Dept. Vic., 1896), and Mr. Herman also recognises the possibility of oblique movement at Walhalla (Report on the Walhalla Goldfield, Mines Dept. Vic., 1901).

Mr. J. T. Freeland, in the paper before referred to, states that "diagonal relative fault movement occurs generally in strongly folded and upturned strata, rarely in flat strata."

In conclusion, I would acknowledge my indebtedness to various mine managers and others who have given me valuable information and facilities for observation, and especially to Messrs. Trethowan (Senior and Junior), Pearse and Tregurtha, of the North Woah Hawp; New Normanby, and Normanby North (formerly Speedwell), Companies respectively.

ART. XXI.—*Field Practice with the Aneroid Barometer.*

BY PROFESSOR W. C. KERNOT, M.A., M.C.E.

[Read 8th December, 1903].

This instrument measures the pressure of the atmosphere by means of an exhausted metallic chamber kept from collapsing by a powerful spring, the motion under varying pressures being magnified by a delicate lever system so as to become easily visible. It constitutes a cheap and portable substitute for the more perfect mercurial barometer, and is subject to the same limitations and also to special defects of its own, which, if not allowed for, render its indications comparatively unreliable. With proper care, however, in choosing, testing and using, it is sufficiently accurate for many purposes connected with exploration, surveying and engineering, and vastly more convenient than the cumbrous, fragile and costly mercurial barometer. Extreme differences of opinion have existed amongst experts as to the aneroid, some regarding it as hopelessly unreliable, while others quote examples of astonishingly accurate work done by its means. As is not uncommon in other cases the truth lies between these extremes. The former view is the natural result of neglecting to test the instrument and allow for its errors, which may involve hundreds of feet difference of level, even in good instruments, and which vary enormously in individual cases. For example, a certain aneroid tested at the University gave at one part of its range 1200 feet difference of level, when it ought to have given only 1000. Another tested at the same time was almost as perfect as a mercurial at that particular part of its scale, but had an error of 100 feet in 500 at another place. Both these instruments were used most successfully in the field, when these errors were known and allowed for, which without this knowledge would have been almost useless. On the other hand, the extraordinarily accurate results sometimes quoted for aneroid levelling are no doubt due to good fortune, and the tendency to recollect and quote the successful and forget the unsuccessful instances. As the result of a fairly large experience, it may be laid down that, to determine differences of level up to 100 feet, within 5 feet of the truth, up to 1000 feet within 10 feet, and greater altitudes within 1 per cent. of their total amount, is excellent work, while errors of twice the above amount will mark a fair average performance.

Choice of Instrument.

Neither appearance nor cost is reliable evidence of quality—cheap and rough-looking aneroids have sometimes performed admirably; costly and apparently highly-finished ones, owing to hidden defects, the reverse. The name of a good maker is some guarantee, but should not be too much relied on. Some aneroids are made very small; while admitting that diminutive instruments *may be* accurate, it is a safer course to avoid them, and prefer those with a dial not less than 2 inches diameter. In them the mechanism is more easily made delicate enough and the larger dial shows small differences of pressure more clearly. Instruments with dials 4 or 5 inches diameter are better still, but are costly and rather cumbersome to carry. Whether the face is open, showing the mechanism or not, is immaterial. Some aneroids profess to be compensated against changes of temperature, others do not. In the first case, too much reliance should not be placed on the accuracy of the compensation, for at best it is rather rough; in the latter the instrument should be carefully tested at different temperatures, and a table of temperature corrections drawn up and applied to the readings. The best way is to work only when the weather is neither extremely warm nor cold, and to keep the instrument in an inner pocket, when it will approach to the temperature of the body.

Testing the Instrument.

Every instrument when purchased should be carefully tested in the vacuum chamber, and this test should be repeated if possible every six months. Should the instrument fall or receive a severe knock, it should at once be re-tested as its table of corrections may be modified. The vacuum chamber may be exhausted by a water jet aspirator, or by a mechanical air pump, and the degree of exhaustion is determined by a mercurial or water barometer, the upper end of which communicates with the vacuum chamber. A water barometer 8 feet high is sufficient for the State of Victoria, where altitudes of over 6000 feet are rare.

In testing, the aneroid should be placed in the chamber, and the pressure slowly reduced by half-an-inch of mercury each time till the limit is reached. Then the pressure should be slowly increased by half-an-inch of mercury each time till atmospheric pressure is regained. This should be done as near the sea level

as possible, and preferably when the barometer is high, otherwise, possibly, part of the range of the aneroid, and that a most important part, may remain un-tested. While in the chamber, the instrument should be most carefully watched, and its readings noted accurately. It is of vital importance that the index move smoothly and without any sticking or jerking, and that the indications be exactly the same with reducing as with increasing pressure. Friction, and especially irregular friction, of the multiplying mechanism, is a most fatal defect in an aneroid. A gentle tapping or scratching with the thumb nail will set up vibration, and so diminish friction. This is generally used in the field, and some appliance for enabling it to be done in the vacuum chamber is desirable. The readings at every half-inch of mercury having been taken and compared with the barometer, a table, or better still a diagram, of corrections should be made, and used to correct all readings taken in the field.

In the absence of a vacuum chamber, a fairly good test may be made on a railway that rises rapidly, and has numerous stations at known levels. The railway from Penrith to Katoomba, in New South Wales, which rises over 3000 feet in 30 miles, would answer well. The rack railways, now so common in Switzerland and other mountainous countries, which rise several thousand feet in a few miles, would be better still. By repeating the test with varying barometric pressures, about 1000 feet more of the range of the instrument may be verified. The same thing may be done for a small part of the range in a tall building such as the Eiffel Tower at Paris, or even the tall business premises existing in Melbourne. The height of the building is best measured by a steel tape line, but by counting the steps of the staircases and measuring the height of a step, a very fair approximation may be obtained.

In these cases the proper difference of reading is computed from the height by means of the appropriate tables, and the actual difference by aneroid being compared therewith, the correction is obtained. It is to be noted that the actual magnitude of the corrections is of no importance. All that is necessary is that they should be accurately known. It is a convenience to have them all additive. If they are not so, they may often be made so by turning the adjusting screw at the back of the instrument.

USING THE ANEROID.

As some instruments otherwise good vary their reading considerably according to the position in which they are held, it is well always to read with the dial horizontal. A lens may be used, and in any case, to avoid parallax, try to look at right angles to the dial. A mirror dial, as applied to some electrical instruments, would be theoretically perfect, for when the index covered its reflection, there would be no parallax. A small metal flag is sometimes put at the end of the index, and this, by becoming invisible, shows that the line of sight is perpendicular. The ordinary index, however, if it works fairly close to the dial, and is read carefully, will give very good results. If a very rapid ascent or descent of several hundred feet is made, it is well to give the instrument a few minutes' rest before reading it, as it does not always immediately adapt itself to a large change of pressure. For the same reason, testing in the vacuum chamber should be performed slowly, and a pause of a minute, at least, made at each point of comparison. For good work it is suggested that two aneroids and a barograph, or self-recording aneroid, be employed. This instrument should, if possible, be tested in the vacuum chamber as are the aneroids. It is not so important, however, to do this, as the range of the barograph is much smaller than of the aneroids, and the risk of error consequently less. The barograph is left at the starting or datum point, and shows every variation of atmospheric pressure there. This is better than trusting to a cook or camp keeper, who may be unskilful or negligent in reading the instrument left with him. The two aneroids, by the substantial agreement of their corrected readings, will give asssurance that both are working well, while a marked difference will show that something is wrong, and lead to further investigation. Each reading is booked, and the time by the watch noted, so that the corresponding barograph reading may be ascertained. On leaving and on returning to camp, the aneroids and barograph should be compared together, and any small inconsistency noted and distributed over the observations.

Thermometer readings should also be taken at the camp and at the aneroid stations, but these need not be nearly so precise as the aneroid readings. If expense is no object, a thermograph, or self-recording thermometer, may be kept at the camp or

starting point, as well as a barograph, but this is rarely necessary. Every opportunity that presents itself of comparing the aneroid with a good mercurial barometer should be taken advantage of as a check.

Reducing the Observations and Computing the Altitudes

Many formulae and tables have been published for this purpose, but most of them are needlessly cumbrous. There is no need of computing decimals of a foot when the instrument will not indicate anything less than 10 feet, or 5 feet at the very closest, and when continual atmospheric variations affect the result by several feet in perhaps a few minutes of time. The same may be said of such theoretical refinements as correction for the variation of gravity due to latitude or altitude.

Table I.

The following table, founded on those of Laplace and Guyot, is recommended for use in Victoria:—

Inches of Mercury.	Feet.	Difference.	Inches of Mercury.	Feet.	Difference.
23.5	0		24.8	1406	
		111			105
6	111		9	1511	
		110			105
7	221		25.0	1616	
		110			105
8	331		1	1721	
		110			104
9	441		2	1825	
		109			103
24.0	550		3	1928	
		109			103
1	659		4	2031	
		108			103
2	767		5	2134	
		108			102
3	875		6	2236	
		107			102
4	982		7	2338	
		107			101
5	1089		8	2439	
		107			101
6	1196		9	2540	
		105			101
7	1301		26.0	2641	
		105			100

Inches of Mercury.	Feet.	Difference.	Inches of Mercury.	Feet.	Difference.
26.1	2741	100	28.6	5131	91
2	2841	100	7	5222	91
3	2941	99	8	5313	91
4	3040	99	9	5404	90
5	3139	98	29.0	5494	90
6	3237	98	1	5584	90
7	3335	98	2	5674	89
8	3433	97	3	5763	89
9	3530	97	4	5852	89
27.0	3627	97	5	5941	88
1	3724	96	6	6029	88
2	3820	96	7	6117	88
3	3916	95	8	6205	88
4	4011	95	9	6293	87
5	4106	95	30.0	6380	87
6	4201	95	1	6467	87
7	4296	94	2	6554	86
8	4390	94	3	6640	86
9	4484	93	4	6726	86
28.0	4577	93	5	6812	85
1	4670	93	6	6897	85
2	4763	93	7	6982	85
3	4856	92	8	7067	85
4	4948	92	9	7152	84
5	5040	91	31.0	7236	

By taking the difference of the figures in the second column of the preceding Table, opposite the two readings found in the first

column, the difference in altitude of the two points is found. But this Table is correct only where the average temperature of the air is 32° F. For any higher temperature the result must be increased in the subjoined ratio.

TABLE II.

Temperature.		Multiplier.	Temperature.		Multiplier.
32°	-	1.00	68°	-	1.08
37°	-	1.01	72°	-	1.09
41°	-	1.02	77°	-	1.10
46°	-	1.03	81°	-	1.11
50°	-	1.04	86°	-	1.12
54°	-	1.05	90°	-	1.13
59°	-	1.06	95°	-	1.14
63°	-	1.07	100°	-	1.15

EXAMPLE.

Reading at lower station - -	28.61	
Instrumental correction - -	.04	
	28.65	
Corresponding number from Table I. -		$5131 + \frac{5}{10}\,91 = 5176$
Reading at upper station - -	26.78	
Instrumental correction - -	.06	
	26.84	
Corresponding number from Table I. -		$3433 + \frac{4}{10}\,97 = 3472$
Difference - - -		1704

Average temperature of intermediate air 60° F.

Multiplier from Table II. 1.062. $1704 \times 1.062 = 1809.6$ feet.

The same example worked out from Guyot's Tables, which are much more voluminous than the preceding, gave 1810.3 as the result, or about 8 inches more. It is not too much to state that no aneroid in existence could be depended upon to give this height by a single pair of observations within several feet of the truth. Thus this discrepancy is seen to be absolutely unimportant.

Easier but Rougher Methods.

Where less precision is needed the following rule may be used. Taking the average temperature of the air as 50° F. in ordinary winter, and 77° F. in ordinary summer weather.

	For each $\frac{1}{100}$ inch allow In Winter.	For each $\frac{1}{100}$ inch allow In Summer.
From 31 to 30 inches	8.9 ft.	9.4 ft.
,, 30 ,, 29 ,,	9.2 ,,	9.8 ,,
,, 29 ,, 28 ,,	9.5 ,,	10.1 ,,
,, 28 ,, 27 ,,	9.9 ,,	10.4 ,,
,, 27 ,, 26 ,,	10.2 ,,	10.8 ,,

In spring or autumn the mean of the summer and winter results may be taken.

To put it another way a difference of readings of 30 to 29 inches represents 1000 feet at a temperature of 88° Fahrenheit, 950 feet at 62°, and 900 feet at 40°; 29 to 28 inches represents 1000 feet at 75°, 950 feet at 50°, and 900 feet at 25°; 28 to 27 inches represents 1000 feet at 54°, and 950 feet at 32°.

A still quicker and easier way is to allow 10 feet for each $\frac{1}{100}$ inch of mercury in summer, and 9½ feet in winter for all heights up to 3000 feet above sea. This will usually give results within about 3 or 4 per cent. of the truth.

Examples of Successful Work.

1. In a building, an aneroid was carried upstairs and read at several known levels. It was then carried down and read a second time at each level. From the mean readings the heights were computed as below:—

By aneroid	6.7	19.2	35.5	69
By actual measurement	8.8	23.8	37.5	66.6

2. Four readings were taken, at intervals of several hours, at a point on the Geelong Waterworks, the level of which was accurately known, and compared with simultaneous readings at the Melbourne Observatory, 40 miles distant. The true difference of level was 760 feet, and the aneroid results varied from

12

752 to 756 feet. The intervening country was comparatively level and open.

3. A barograph was left at Croydon Railway Station. Three aneroids were taken to the top of Mount Dandenong, six miles distant, and nearly 1700 feet higher. Each aneroid was read nine times, beginning at 10.30 a.m., and ending at 4 p.m., and the height of the mountain computed, taking Croydon as the datum point. The three aneroids gave 2064, 2057, and 2046 feet respectively, above sea level, while the trigonometrical survey height on the large Government map of Victoria is 2060.

4. A barograph was left at Moe Railway Station. Three aneroids were taken to a point on Mount Baw Baw, 25 miles to the north, and about 5000 feet above Moe, and read once only, as the party had to return immediately. The results on being worked out gave 5235, 5301, and 5258 feet above sea respectively, for the three instruments. On a subsequent occasion a party camped for several days at the same place and made hourly readings of two good mercurial barometers, the results of which gave 5200.

5. The instrument mentioned in example 2 was taken by railway from Sydney to Brisbane, 720 miles, over country rising at one point 4500 feet above sea, and agreed throughout with the railway levels within 3 per cent. It was also taken by railway from Durban to Capetown, in South Africa, *viâ* Pretoria, a distance of fully 1500 miles, the country rising in parts to over 5000 feet above sea, and give the heights of the railway stations within 5 per cent. of the truth. These results should answer doubts that have been expressed as to the utility of aneroid levelling in extensive explorations.

General Recommendations.

Properly tested aneroids, used with judgment and suitable precautions, are capable of doing very useful work, but too much must not be expected from them. They should be used in conjunction with a barograph placed preferably at a railway station or other point, the level of which is accurately known. From such a point as a centre, it is possible to do fairly good work for a radius of say 20 miles in open country, and 10 miles

in rangy country. If it is necessary to go further than this from known levels, new datum points should be established, and connected by a series of repeated observations with the railway station or other known point. Aneroid work should not be attempted in stormy weather, or when atmospheric conditions are specially unsettled, nor in extremely hot or extremely cold weather.

Should the expense not be too great, it would be well to have two barographs placed at two points in the district surveyed, as far apart in distance and at as great a difference of elevation as is conveniently attainable, and take the mean of the two as giving the true variation of pressure. There should in many cases be no insuperable difficulty in doing this, as a decent barograph may be purchased for £5, and it will need attention but once a week. If any meteorological station exists within say 50 miles of the work in open, or 25 miles in rangy conntry, the readings obtained there should be used as far as possible as a check on the barograph. If no such station be available, it will conduce to accuracy to have a mercurial barometer or boiling-point hypsometrical apparatus at the barograph station, and check both barograph and aneroid by its means as often as convenient. A comparison every week is suggested as a minimum. The mercurial barometer or boiling-point apparatus might be occasionally taken out in the field as a check on the aneroids there. This, however, would probably only be done for specially important points, such as new barograph stations, as it would involve considerable extra labour. Narrow and deep valleys are bad as barograph stations, as in them the pressure varies with the temperature in such a way as to make the station appear too high in the day time and too low at night. The barograph will read correctly only at say 9 a.m. and 2 p.m.

Ranges of mountains act as atmospheric dams, causing the pressure at the same level on the two sides to vary by amounts corresponding to 50 or even 100 feet difference of altitude. Hence, on passing such a range, new datum points of known level should be sought.

In reducing aneroid observations taken on a long journey or exploration, the simultaneous readings at stations of known level should be taken into account. For example, in reducing obser-

vations taken during a journey across Australia, the isobaric charts published by the Observatory would give the probable sea-level reading at each point, from which and the actual reading the height is determined. Work of this sort, however, though by no means without value, cannot possibly approach in precision that done under more favourable conditions.

In compiling the above notes, use has been made of Bulletin No. 8 of the Department of Mines of Victoria, by Professor Gregory, F.R.S., and valuable hints have been received from Mr. T. W. Fowler, M.C.E., Lecturer on Surveying, Melbourne University. To these gentlemen thanks are accordingly given.

Note.—Whymper and others have called attention to the mechanical hysteresis, or fatigue of the aneroid spring, as a source of serious error, and a special instrument has been devised to obviate it. This trouble, which was serious at high altitudes in the Andes, does not appear to be of practical importance on the very moderate elevations found in Australia.

An aneroid with optical instead of mechanical magnification has been brought out by Goldschmidt, to eliminate friction errors, but, so far, does not appear to have gained much favour.

ANNUAL REPORT OF THE COUNCIL

FOR THE YEAR 1902.

The Council of the Royal Society herewith presents to the Members of the Society the Annual Report and Statement of Receipts and Expenditure for the year 1902.

The following Meetings were held :—

March 13.—*Paper read:* "The Theory of Temporary Stars," by E. F. J. Love, M.A., F.R.A.S.

April 4.—*Papers read:* 1. "On the Occurrence of Glacial Beds at Wynward, near Table Cape, Tasmania," by A. E. Kitson, F.G.S. 2. "Further Descriptions of the Tertiary Polyzoa of Victoria, Part VIII.," by C. M. Maplestone.

May 8.—*Paper read*: "Six Months' Daily Examination of Melbourne Tap Water," by Thomas Cherry, M.D., M.S.

June 12.—*Papers read:* 1. "Notes on Some Recent Marine Deposits in the Neighbourhood of Williamstown," by F. E. Grant and E. O. Thiele. 2. "Description of Some New Victorian Fresh-water Amphipoda, No. 2," by O. A. Sayce. 3. "Further Notes on the River Yarra Improvement Sections, at the Botanical Gardens, Melbourne," by A. E. Kitson, F.G.S. *Exhibits:* 1. Mr. Arthur Everett showed and described the New Geological Map of Victoria. 2. Rev. A. W. Cresswell, M.A., exhibited and discussed the use of the Gastroliths of Astacopsis. 3. Mr. H. Bullen showed some Gem-sand under the microscope.

July 10.—*Papers read:* 1. "Some Little-known Victorian Decapod Crustacea, with Descriptions of New Species, No. 2," by S. W. Fulton and F. E. Grant. 2. Description of Some New Lizards from Western Australia," by A. H. S. Lucas, M.A., B.Sc., and C. Frost, F.L.S. 3. "New or Little-known Fossils from the Tertiaries of Victoria," by T. S. Hall, M.A. *Exhibits:* 1. By Mr. Fulton, Crustacea, in illustration of his paper. 2. By Mr. Hall, Fossils described in his paper.

August 14.—*Demonstration:* Mr. Wilfrid N. Kernot, B.C.E., showed some of the remarkable results recently obtained by M. Tesla.

September 9.—*Papers read:* 1. "A Possible New Chemical Element," by E. F. J. LOVE, M.A. 2. "Contributions to the Palaeontology of the Older Tertiary of Victoria; Lamellibranchs, Part III.," by G. B. PRITCHARD. 3. "New or Little-known Victorian Fossils in the National Museum, Melbourne; Part I. —Some Palaeozoic Species," by FREDERICK CHAPMAN, A.L.S., &c. 4. "The Age of the Metamorphic Rocks of North-Eastern Victoria," by Professor J. W. GREGORY, D.Sc., F.R.S.

October 9.—*Papers read:* 1. "Description of Two New Australian Lizards, Varanus spenceri and Diplodactylus bilineatus," by A. H. S. LUCAS, M.A., B.Sc., and C. FROST, F.L.S. 2. "On some Rocks from the Fairway of Port Phillip Heads," by F. E. GRANT and E. O. THIELE. 3. "Coorongite, a South Australian Elaterite," by ALEX. C. CUMMING. 4. "Catalogue of the Marine Shells of Victoria," by G. B. PRITCHARD and J. H. GATLIFF. 5. "A New Ammonite from the Cretaceous Rocks of Queensland," by Professor J. W. GREGORY, D.Sc., F.R.S., and F. VOSS SMITH. *Demonstration:* Messrs. J. PATTERSON and ROBT. W. HARVIE showed and explained a process of Natural Colour Photography and Ives Method of Lantern Projection. *Exhibits:* 1. Trustees of the National Museum, Varanus spenceri and Diplodactylus bilineatus. 2. Professor J. W. GREGORY, the New Ammonite described. 3. Mr. A. C. CUMMING, specimens of the Mineral (Coorongite) dealt with in his paper.

November 13.—*Paper:* "The Heathcotian—a Pre-Ordovician Series—and its Distribution in Victoria," by Professor J. W. GREGORY, D.Sc., F.R.S. *Exhibits:* Mr. E. J. DUNN showed two fragments of calvaria from a Maori burial place, and drew attention to what he considered evidence of low organisation.

December 11.—*Papers read:* 1. "The Ores and Associated Rocks of the Mitta Mitta Valley," by H. C. Jenkins, A.R.S.M. 2. "The Phyllopoda of Australia, including descriptions of some new Genera and Species," by O. A. Sayce. *Exhibits:* 1. By Mr. Jenkins, Rocks and Rock-slices illustrating his paper. 2. By Mr. Sayce, Australian Phyllopoda.

The interior of the Society's Hall has been throughly renovated during the year. Our numbers have been increased by the election of three members, six associates, and one country member, while one member has resigned and another has become an associate. We have also to record the loss by death of Mr. C. R. Blackett, for many years Honorary Treasurer of the Society, Major-General Sir Andrew Clarke, K.C.M.G., an Honorary Member and one of tha founders and Past Presidents of the Society, and Sir Frederick Sargood, K.C.M.G., who was a member for many years.

The following publications were issued during the year: "Proceedings," Vol. XIV., Pt. 2, and Vol. XV., Pts. 1 and 2.

The Library continues to grow at a rapid rate, and 1318 additions have been received. A large number of Societies have been added to our exchange list, the most important being the British Museum (Nat. Hist.) and the Zoological Society of London. Funds are still urgently needed for additional shelving and for binding.

The Honorary Treasurer in Account with the Royal Society of Victoria.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance from 1901	£278	15	3	By Printing and Stationery	£141	2	8
Government Grant—				Postages	16	0	7
Vote for 1901-1902	100	0	0	Freight and Sundries	13	1	3
First Moiety of Vote of £50, 1902-1903	25	0	0	Salary of Assistant-Secretary	25	0	0
Subscriptions—				Custodian	6	0	0
Members	54	12	0	Rates	5	13	4
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Rent of Rooms	9	2	6	Books and Periodicals	1	16	6
Transactions	0	19	6	Bookbinding	0	18	6
Interest	3	1	2	Furniture and Fittings	3	18	6
				Recoup Publishing Fund	200	0	0
				Collector's Commission	6	0	0
				Gas and Fuel	6	11	3
				Refreshments	4	11	6
					£481	5	5
				Balance	59	16	0
	£541	1	5		£541	1	5

PUBLISHING AND RESEARCH FUND.

Dr.	£	s.	d.	Cr.	£	s.	d.
To Balance from 1901	£100	0	0	By Balance (on Fixed Deposit in Bank of Australasia)	£300	0	0
Recoup from General Account ...	200	0	0				
	£300	0	0		£300	0	0

Compared with the Vouchers, Bank Pass-Book, and found correct,

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3rd *March*, 1903.

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1903.

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Bailey, F. M., F.L.S., Government Botanist, Brisbane, Queensland 1880

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Danks, A. T., 391 Bourke-street west, Melbourne ... 1883

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Fulton, S. W., 369 Collins-street, Melbourne 1900

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Gatliff, J. H., Commercial Bank of Australasia, Lygon-street, Carlton ... 1898
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Green, W. Heber, B.Sc., University, Melbourne ... 1896
Grayson, H. J., University, Melbourne 1902

Hall, Robt., Elgar Road, Box Hill 1900
Hardy, A. D., Lands Department, Melbourne 1903
Herman, Hyman, B.C.E., Department of Mines, Melb. 1897
Holmes, W. A., Telegraph Engineer's Office, Railway Department, Melbourne ... 1879

Ingamells, F. N., Observatory, Melbourne 1889

Jobbins, G. G., Electric Lighting Coy., 31 Queen-street, City ... 1902
Jutson, J. T., Normanby Avenue, Northcote 1902

Kenyon, A. S., Heidelberg... 1901
Kernot, Frederick A., 66 Russell-street, Melbourne ... 1881
Kitson, A. E., F.G.S., Mining Department, Melbourne 1894

Lambert, Thomas, Bank of New South Wales, Collins-street, Melbourne ... 1890
Le Souef, D., C.M.Z.S., Royal Park, Melbourne 1894
Lidgey, E. A., 41 Burke Crescent, Geelong 1894
Luly, W. H., Department of Lands, Treasury, Melbourne 1896

Maclean, C. W., "Bronte," Strand, Williamstown ... 1879
Mahony, D. J., "Laremont," Bruce-street, Toorak ... 1901
Mattingley, A. H. E., 6 Alfred-street, N. Melbourne ... 1903
Mathew, Rev. John, M.A., B.D., Coburg 1890
McEwan, John, 70 Swanston-street 1898

Melville, A. G., Mullen's Library, Collins-street east, Melbourne ... 1889
Menz, R. 1902

O'Neill, W. J., Lands Department, Melbourne 1903

Phillips, A. E., Box 396, G.P.O., Melbourne 1883
Pritchard, G. B., Mantell-street, Moonee Ponds, Victoria 1892

Sayce, O. A., Harcourt-street, Hawthorn 1898
Schafer, R., "Invercloy," Napier-street, Essendon ... 1883
Shaw, Alfred C., Bond-street, Abbotsford, Victoria ... 1896
Smith, F. Voss, "Earlscourt," Glenferrie-road, Hawthorn 1901
Smith, G. P., "Earlscourt," Glenferrie-road, Hawthorn ... 1901
Stephen, Rev. R., M.A., Trinity College, Parkville ... 1901
Stewart, C., M.C.E., Shire Hall, Preston 1883
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Sutton, E. H., "Claremont," The Avenue, Windsor ... 1902

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Tisdall, H. T., 7 Washington-street, Toorak 1883
Traill, J. C., B.A., B.C.E., "Ormea," Mercer-road, Malvern 1903

Wedeles. James, 231 Flinders Lane, Melbourne 1896
Weindorfer, G., Austro-Hungarian Consulate, Melbourne 1903
Woodward, J. H., Queen's Buildings, Rathdowne-street, Carlton 1903

INDEX.

(The names of new genera and species are printed in Italics).

END OF VOLUME XVI.

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